

NECESSARY UPDATES TO THE COMMERCIAL SPACE LAUNCH ACT

HEARING BEFORE THE SUBCOMMITTEE ON SPACE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY HOUSE OF REPRESENTATIVES ONE HUNDRED THIRTEENTH CONGRESS

SECOND SESSION

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NECESSARY UPDATES TO THE COMMERCIAL SPACE LAUNCH ACT

TUESDAY, FEBRUARY 4, 2014

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON SPACE
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Subcommittee met, pursuant to call, at 2:16 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Steven Palazzo [Chairman of the Subcommittee] presiding.

LAMAR S. SMITH, Texas
CHAIRMAN

EDDIE BERNICE JOHNSON, Texas
RANKING MEMBER

Congress of the United States
House of Representatives

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

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Subcommittee on Space

Necessary Updates to the Commercial Space Launch Act

Tuesday, February 4, 2014

2:00 p.m. to 4:00 p.m.

2318 Rayburn House Office Building

Witnesses

Dr. George Nield, Associate Administrator for Commercial Space Transportation, Federal Aviation Administration

Dr. Alicia Cackley, Director of Financial Markets and Community Investment Team, Government Accountability Office

Dr. Henry Hertzfeld, Research Professor of Space Policy and International Affairs, Elliot School of International Affairs, George Washington University

**U.S. House of Representatives
Committee on Science, Space, and Technology
Subcommittee on Space**

Necessary Updates to the Commercial Space Launch Act

CHARTER

Tuesday, February 4, 2014
2:00 p.m. – 4:00 p.m.
2318 Rayburn House Office Building

Purpose

The Subcommittee on Space will hold a hearing titled *Necessary Updates to the Commercial Space Launch Act* at 2:00 p.m. on Tuesday, February 4th. The industry has grown over the years since the passage of the Commercial Space Launch Act of 1984 (P.L. 98-575) thirty years ago, and this law has been amended several times since then. The Commercial Space Launch Act (CSLA) provides authority to the Federal Aviation Administration (FAA) to license launches and indemnify launch providers from third-party claims should an accident occur. The law also provides a framework for the FAA's regulatory authority. This hearing will examine the various changes in the industry and what, if any, accompanying changes to the Commercial Space Launch Act may be needed going forward.

Witnesses

- **Dr. George Nield** – Associate Administrator for Commercial Space Transportation, Federal Aviation Administration
- **Dr. Alicia Cackley** – Director of Financial Markets and Community Investment Team, Government Accountability Office
- **Dr. Henry Hertzfeld** – Research Professor of Space Policy and International Affairs, Elliot School of International Affairs, George Washington University

Background

In 1984, after mentioning the expendable launch services industry in his State of the Union Address,¹ President Reagan issued Executive Order Number 12465² which directed the Department of Transportation to take the lead on regulating and promoting commercial expendable launch services activities throughout the country. Shortly thereafter, Congress

¹ President Ronald Reagan, State of the Union Address, January 25, 1984.
<http://www.presidency.ucsb.edu/ws/?pid=40205>

² Executive Order Number 12465, published February 24, 1984; Federal Register - 49 FR 7211.
<http://www.archives.gov/federal-register/codification/executive-order/12465.html>

passed the Commercial Space Launch Act (P.L. 98-575) to, “devise an effective legislative framework that will facilitate and control space launch services provided by private enterprise.”³

Prior to the Space Shuttle *Challenger* tragedy in January 1986, the Space Shuttle was the primary vehicle for delivering commercial satellites to orbit. Following the tragedy, Congress and Reagan Administration began work to reverse this policy and develop a new strategy for guaranteed access to space. This policy change also led to various legislative initiatives including the Assured Access to Space Act of 1986 and NASA Authorization Act of 1987.⁴ On December 27, 1986, President Reagan issued National Security Decision Directive 254 (NSDD-254) which ended NASA’s role in launching commercial and foreign satellites except in the interest of national security, foreign policy, or a payload unique to Shuttle.⁵

In 1988, Congress passed and President Reagan signed the Commercial Space Launch Act Amendments of 1988 (P.L. 100-657). The CSLAA was meant to ensure “that a commercial launch industry takes its place as a significant component of the U.S. space transportation system.”⁶ The most significant amendment in the CSLAA was the creation of the current third-party risk-sharing regime (indemnification) including the “maximum probable loss” calculation which provides an estimate for insurance required to cover possible damages to uninvolved third parties. The indemnification regime will be described later in more detail.

The passage of CSLAA in 1988 solidified the need for development of expendable launch vehicles rather than sole reliance on the Space Shuttle.⁷ This shift in policy by both the President and Congress assured the Space Shuttle would no longer be in competition with the private space launch market and created a need for the development of new rockets.⁸

Since the first FAA-licensed commercial launch in 1989, the FAA Office of Commercial Space Transportation (FAA-AST) has issued 217 launch licenses of which 17 are active for the 2014-2018 timeframe.

Some of the challenges faced by the commercial space industry include outdated regulations and federal laws, compliance with federal export control regimes, and international competition. The commercial space industry also leverages investments made by federal government agencies like the Department of Defense, NASA, and NOAA as part of their business plan. Future growth in the U.S. commercial space sector is highly dependent on the federal government providing an efficient and flexible legal and regulatory framework.

³ Representative Harold Volkmer (MO-9) in floor debate on H.R. 3942, the Commercial Space Launch Act, June 5, 1984.

⁴ Title IV of H.R. 5495, the National Aeronautics and Space Administration Authorization Act of 1987, pocket vetoed by President Ronald Reagan on November 14, 1986.

⁵ National Security Decision Directive 254- National Space Launch Capability, Section C <http://www.reagan.utexas.edu/archives/reference/Scanned%20NSDD254.pdf>

⁶ Rep. Roe (NJ-8) in floor debate on H.R. 4399, the Commercial Space Launch Act Amendments of 1988, May 24, 1988.

⁷ House Committee on Science, Space, and Technology, Committee Report, Commercial Space Launch Act Amendments of 1988, p. 3.

⁸ Although Congress did not pass amendments to the Commercial Space Launch Act until 1988, multiple hearings and legislative attempts made clear the intent of Congress to reverse the standing policy for the use of Shuttle as the main lifting body for commercial payloads following the *Challenger* tragedy.

Key Issues

Third-party Liability Risk-Sharing Regime

The Commercial Space Launch Act Amendments of 1988 (P.L. 100-657) established a tiered risk-sharing regime for third-party liabilities associated with commercial space launch.⁹ The purpose of the regime is to limit the liability of the launch companies for claims made by the uninvolved public.

There are three tiers to the regime. The first tier is the responsibility of the launch provider. As part of the FAA licensure process for the launch, the provider must purchase insurance that covers third parties, including the government, for injury, loss or damage up to a limit of \$500 million. The limit below the statutory ceiling is determined by FAA as the maximum probable loss (MPL).¹⁰

The second tier is the ‘indemnification’ portion of the regime. If a successful claim were to be in excess of the maximum probable loss, the government is authorized to pay, subject to appropriation, an amount up to a total of \$1.5 billion in claims over the first tier. This ceiling is adjusted for inflation and represents approximately \$2.7 billion as of 2012.¹¹

The final tier is the responsibility of the launch provider. The company or legally responsible party is liable for claims in excess of the maximum probable loss and the authorized \$2.7 billion indemnification.

The creation of the third-party liability regime in the CSLAA was debated extensively in the House Committee on Science, Space, and Technology as well as the House floor. When President Reagan issued NSDD-254, effectively ending the Shuttle’s involvement in commercial satellite launches, there were 44 satellite companies that had launch services agreements with NASA.¹² Following the *Challenger* tragedy and the aggressive campaigns of the Europeans, Japanese, Chinese, and Soviets to launch those commercial satellites,¹³ Congress passed the CSLAA in an attempt to give a backstop to a fledgling industry in hopes of growing domestic U.S. capabilities.

The original legislation included a sunset provision to the launch liability regime which expired five years after passage.¹⁴ Since its original passage, this sunset¹⁵ has been extended 6 times, most recently for 3 years until December 31, 2016.¹⁶

⁹ Section 5(a) of the Commercial Space Launch Act Amendments of 1988 (P.L. 100-657)
<http://www.gpo.gov/fdsys/pkg/STATUTE-102/pdf/STATUTE-102-Pg3900.pdf>

¹⁰ *Ibid.*

¹¹ GAO-12-767T, p. 5, Testimony before the Science, Space, and Technology Committee, June 6, 2012.
<http://www.gao.gov/assets/600/591391.pdf>

¹² *Ibid.*, 6

¹³ *Ibid.*, 6

¹⁴ *Ibid.*, 9

¹⁵ 51 USC 50915

Obligations under the Outer Space Treaty of 1967 and the Liability Convention of 1974

On October 10, 1967, the United States became a signatory to the Outer Space Treaty.¹⁷ Each signatory of the treaty is liable under Article VII for third-party damage “to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the moon and other celestial bodies.” Additionally, the Liability Convention of 1974¹⁸ obligates the United States to cover these damages whether the launch is private or government acquired.¹⁹

The use of the risk-sharing regime to satisfy treaty obligations is a necessary precaution under both documents. Whether the regime was in place or not, the United States would still be obliged to rectify any damages incurred by the injured nation. However, it is unlikely that damages paid to a foreign country would exceed the MPL given the position of our launching facilities and that the early stages of launch are typically the most dangerous.²⁰ It is most likely that any damage would be covered by the first tier of the regime.

Regulatory Learning Period

In 2004, Congress passed the Commercial Space Launch Amendments Act of 2004 (P.L. 108-492) to promote the emerging commercial human spaceflight industry following the successful suborbital flights of the SpaceShipOne, winning the team the \$10 million Ansari X Prize. This legislation included a “regulatory learning period.”²¹ The learning period was included to ensure the FAA would not overregulate the industry before it had the opportunity to grow.²² Without launching and operating commercial human flights, industry and regulators have limited data to inform safety rules, which could lead to uninformed or unnecessary regulations that would stifle the growing industry.

The 2004 Act included a sunset for the learning period which ended in 2012. However, recognizing there was still a great deal of testing and data to gather on these human launch systems, Congress extended the period to October 1, 2015 in the FAA Modernization and Reform Act of 2012.²³

¹⁶ Section 8, Launch Liability Extension- H.R. 3547, the Consolidated Appropriations Act, 2014 <http://www.congress.gov/cgi-lis/lis>

¹⁷ “Treaty on principles governing the activities of states in the exploration and use of outer space, including the moon and other celestial bodies,” opened for signature on January 27, 1967; the Senate gave unanimous consent on October 10, 1967. <http://www.unoosa.org/oosa/SpaceLaw/outerspt.html>

¹⁸ The Convention on International Liability for Damage Caused by Space Objects.

<http://www.oosa.unvienna.org/oosa/SpaceLaw/liability.html>

¹⁹ Article II of “The Convention on International Liability for Damage Caused by Space Objects”

²⁰ Schaefer, Matthew; 2013, “Liability Issues Regarding Third Parties and Space Flight Participants in Commercial Space Activities: The Path Forward”, p.16

http://law.unl.edu/facstaff/faculty/resident/mschaefer.shtml#pubs_articles (Contact author for copy.)

²¹ 51 USC 50905(c)(3)

²² Rep. Rorhabacher (CA-46) in floor debate on H.R. 5382, The Commercial Space Launch Amendments Act of November 19, 2004.

²³ Sec. 827 of the FAA Modernization and Reform Act of 2012 <http://www.gpo.gov/fdsys/pkg/BILLS-112hr658enr/pdf/BILLS-112hr658enr.pdf>

Under the CSLA, launch providers are required to provide informed consent for spaceflight participants, that “the United States Government has not certified the launch vehicle as safe for carrying crew or space flight participants.”²⁴ This informed consent mechanism is meant to insure transparency and full disclosure for the participant that there is an inherent risk in spaceflight and that the FAA has not certified the vehicle as safe for the general public.

The FAA is obliged to enact only those regulations which restrict design features or operating practices that (1) protect the public health and safety, safety of property, national security interests, and foreign policy interests of the United States²⁵; (2) have resulted in a serious or fatal injury; or (3) contributed to an unplanned event or series of events during a licensed or permitted commercial human space flight that posed a high risk of causing a serious or fatal injury.²⁶ Industry representatives and commercial spaceflight advocates have argued that the extension of the learning period is essential for the growth of the commercial suborbital tourism industry.²⁷

Key Questions

In addition to the issues listed above, there are regulatory and statutory issues for consideration such as: the regulation of hybrid launch systems, such as those employed by Virgin Galactic, which uses a carrier aircraft to carry the suborbital vehicle to a certain altitude where it will be released and a rocket engine will carry the vehicle higher; the potential conflict between FAA’s direction to both *promote* and *regulate* the commercial space industry as required under the CSLA²⁸; and including spaceflight participants in the third-party risk-sharing regime.

Key questions for Congress include:

- What is the proper government role in regulating the commercial space sector?
- Does the current regulatory framework facilitate innovation?
- How do current FAA regulatory processes and procedures affect the commercial space market?
- How does the U.S. compare with other nations when it comes to preserving its space industrial base and incubating the emerging commercial market?
- Is the third-party risk-sharing regime still necessary for the commercial space launch market to be internationally competitive?
- Is the regulatory learning period still necessary to encourage growth and innovation?

²⁴ 51 USC 50905(4)(b)

²⁵ 51 USC 50905(c)(4)

²⁶ 51 USC 50905 (c)(2)

²⁷ Mr. Stuart Witt, CEO of Mojave Air and Space Port in testimony before the House Committee on Science, Space, and Technology’s Subcommittee on Space, November 20, 2013.

²⁸ 51 USC 50903

Chairman PALAZZO. The Subcommittee on Space will come to order.

Good afternoon. Welcome to today's hearing entitled "Necessary Updates to the Commercial Space Launch Act." In front of you are packets containing the written testimony, biographies, and required truth-in-testimony disclosures for today's witnesses. I recognize myself for five minutes for an opening statement.

I want to take a moment to acknowledge the NASA Day of Remembrance, which was observed last Friday as a tribute to the crews of Apollo I and the Space Shuttles *Columbia* and *Challenger*. These men and women lost their lives in the pursuit of exploration and discovery and they will never be forgotten.

In his 1984 State of the Union speech, President Reagan reminded us that our progress in space "is a tribute to American teamwork and excellence." He challenged our best and brightest to develop launch companies ready to lift payloads to orbit regularly with minimal government interference. Shortly after his speech, Congress responded with passage of the Commercial Space Launch Act.

As we once more consider changes to this groundbreaking legislation, President Reagan's words ring just as true for us today as they did three decades ago. We must continue providing a framework for supporting the development of commercial space launch. As the commercial space industry evolves, so too should our laws and federal regulations. While there are many issues we will address in the next CSLA, it is my desire that we give special focus to issues surrounding launch indemnification and the regulatory learning period.

The third-party liability risk-sharing regime, which we know today as indemnification, provided a much-needed safety net for new companies that were developing to fill the Nation's launch needs after commercial satellite launches with Shuttle ended. Since it was first created in 1988, the regime has been extended six times, most recently a few weeks ago on the omnibus spending bill. I look forward to hearing what our witnesses have to say about this provision and any changes to it that might be helpful.

In 2004, as part of the Commercial Space Launch Amendments Act, Congress placed a moratorium on most regulations related to spaceflight participants and vehicle design to ensure ample flexibility for a developing commercial human space launch industry. The need for this provision at the time was clear: How can the FAA regulate an industry that does not exist and has not flown a single paying customer? Today, the situation hasn't changed much. The FAA still has no data to use for regulations and the commercial human space launch industry is still working hard to get off the ground.

The Commercial Crew Development Program at NASA has done a lot to move the industry along by providing an anchor tenant for orbital commercial human spaceflight, funding for early stage development, and funding to mature spacecraft designs. While the suborbital market seems to be maturing rapidly, it is still not clear that there is a business case for nongovernment orbital human space tourism in the near future. What is clear is that if the FAA begins trampling on these companies with regulations based in

speculation instead of data, we may never see the promise of commercial human spaceflight realized. The learning period will expire in 2015 and I look forward to what our witnesses have to say about this provision and its relative importance to the industry.

There are many other issues that may need to be addressed in a potential commercial space bill such as streamlining the permitting process, offering more flexibility for experimental aircraft, better defining the various types of spacecraft, and strengthening the informed consent provisions. We must also ensure that export controls and International Trafficking in Arms Regulations are rational and productive. We need to provide stable, certain, and competitive regulatory environments at the Federal Aviation Administration, the Federal Communications Commission, and the National Oceanic and Atmospheric Administration that facilitate domestic investment.

I have to mention that as I prepared for this hearing I reviewed an article in the Journal of Space Law, which is published by the University of Mississippi School of Law. Ole Miss has a world premier space law program, and I am happy to know that Mississippi is at the forefront of these challenging issues. I look forward to working with both sides of the aisle in the next few months to come up with bipartisan solutions to these issues. There is a lot of promise in the future of commercial spaceflight, and if we work together, I know we can put in place policies that will help grow our economy and this great industry.

With that, I yield to the Ranking Member, the gentlewoman from Maryland, Ms. Edwards.

[The prepared statement of Mr. Palazzo follows:]

PREPARED STATEMENT OF SUBCOMMITTEE ON SPACE CHAIRMAN STEVEN PALAZZO

Chairman Palazzo: Good morning. I would like to welcome everyone to our hearing today and I want to thank our witnesses for taking time to appear before the Committee.

Before we get started I want to take a moment to acknowledge the NASA Day of Remembrance, which was observed last Friday, as a tribute to the crews of Apollo 1 and the space shuttles Columbia and Challenger. These men and women lost their lives in the pursuit of exploration and discovery, and they will never be forgotten.

In his 1984 State of the Union speech, President Reagan reminded us that our progress in space "is a tribute to American teamwork and excellence." He challenged our best and brightest to develop launch companies ready to lift payloads to orbit regularly with minimal government interference. Shortly after his speech, Congress responded with passage of the Commercial Space Launch Act.

As we once more consider changes to this ground-breaking legislation, President Reagan's words ring just as true for us today as they did three decades ago. We must continue providing a framework for supporting the development of commercial space launch. As the commercial space industry evolves, so too should our laws and federal regulations. While there are many issues we will address in the next CSLA, it is my desire that we give special focus to issues surrounding launch indemnification and the regulatory learning period.

The third-party liability risk-sharing regime, which we know today as indemnification, provided a much needed safety net for new companies that were developing to fill the nation's launch needs after commercial satellite launches with shuttle ended. Since it was first created in 1988, the regime has been extended six times, most recently a few weeks ago on the omnibus spending bill. I look forward to hearing what our witnesses have to say about this provision and any changes to it that might be helpful.

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launch industry. The need for this provision at the time was clear, how can the FAA regulate an industry that does not exist and has not flown a single paying customer? Today, the situation hasn't changed much. The FAA still has no data to use for regulations and the commercial human space launch industry is still working hard to get off the ground.

The Commercial Crew Development Program at NASA has done a lot to move the industry along by providing an anchor tenant for orbital commercial human spaceflight, funding for early stage development, and funding to mature spacecraft designs. While the suborbital market seems to be maturing rapidly, it is still not clear that there is a business case for non-government orbital human space tourism in the near future. What is clear is that if the FAA begins trampling on these companies with regulations based in speculation instead of data, we may never see the promise of commercial human spaceflight realized. The learning period will expire in 2015 and I look forward to what our witnesses have to say about this provision and its relative importance to the industry.

There are many other issues that may need to be address in a potential commercial space bill such as streamlining the permitting process, offering more flexibility for experimental aircraft, better defining the various types of spacecraft, and strengthening the informed consent provisions. We must also ensure that export controls and International Trafficking in Arms Regulations (ITAR) are rational and productive. We need to provide stable, certain, and competitive regulatory environments at the Federal Aviation Administration (FAA), the Federal Communications Commission (FCC), and the National Oceanic and Atmospheric Administration (NOAA) that facilitate domestic investment.

I have to mention that as I prepared for this hearing I reviewed an article in the Journal of Space Law, which is published by the University of Mississippi School of Law. Ole' Miss has a world premier space law program, and I'm happy to know that Mississippi is at the forefront of these challenging issues. I look forward to working with both sides of the aisle in the next few months to come up with bipartisan solutions to these issues. There is a lot of promise in the future of commercial spaceflight. If we work together I know we can put in place policies that will help grow our economy and this great industry.

With that I recognize the ranking member, Ms. Edwards, for an opening statement.

Ms. EDWARDS. Thank you very much, Mr. Chairman. And I hope you all will bear with my voice. I promised the Chairman of the full Committee that I would go easy on him today because I don't have a voice and I will honor that promise.

I appreciate all our witnesses here today. Looking back to when the Commercial Space Launch Act was passed in 1984 and I think it is—and then amendments of course in 1988 and 2004, and I think it is fair to say that the commercial space industry indeed has come a long way. Not only has it come a long way but it is growing and changing every day as companies and entrepreneurs continue to generate new ideas and technical concepts for potential commercial space transportation systems. Mr. Chairman, I think this type of ingenuity and innovative spirit that defines our Nation and our economic potential is great and I want to see it succeed.

And as I said before, I am one of those adventurers who wants to be a passenger, but of course I want it to be safe. And of course my enthusiasm is tempered by the recognition that there are a number of questions that remain outstanding in this growing industry that need to be answered and issues that need to be resolved.

The recently passed extension in the third-party liability indemnification regime for three years I think means that we have the time for a thorough and thoughtful examination of these questions, and I look forward to our Subcommittee conducting future hearings to address them. For example, should we be providing indemnification permanently or should we be laying the groundwork for an insurance-based regime? How might such a transition occur and on

what timeline? What would such a transition mean for the insurance industry? And what other industry models can we examine for good practices? There are also questions about how liability should be treated for passengers or spaceflight participants as they are called, and that brings me to the question of whether the policy and regulation for commercial spaceflight with humans should differ from that for commercial launches carrying satellites, cargo, or other payloads, which have comprised the commercial space industry to date.

In short, the real question is whether a one-size-fits-all approach to commercial space transportation and policy and regulation are appropriate for this industry or should we consider different frameworks for commercial human and commercial un-crewed space transportation systems? Already we are seeing existing statute being tested every day by the evolving nature of the industry. So I hope that we are going to be able to answer some of these questions.

I am going to enter my full statement into the record so that I can relieve your ears of my voice, but I will say that I think this sampling of the range of questions for our witnesses today tells us that we have so much more to learn, and I really do hope that this Committee will do what is intended and, that is, really thoroughly and thoughtfully examine all of these questions, because I think it is important both for the maturing and growing industry but it is also important for any potential passenger and crews.

And I know that we hadn't had that time before, but certainly with this three-year extension in place, we have the time for that kind of thoughtful consideration right now. And we also have the time to examine other industries that have evolved and we have examples of them that may show us some window into the way that we need to deal with the potential liabilities of this industry. And with that, I yield.

[The prepared statement of Ms. Edwards follows:]

PREPARED STATEMENT OF SUBCOMMITTEE ON SPACE
RANKING MEMBER DONNA EDWARDS

Thank you, Mr. Chairman, for holding today's hearing on "Necessary Updates to the Commercial Space Launch Act," and welcome to our witnesses. Looking back to when the Commercial Space Launch Act (CSLA) was passed in 1984, followed by the Commercial Space Launch Act Amendments in 1988, and the Commercial Space Launch Amendments Act in 2004, it is fair to say that the commercial space industry has come a long way. Not only has it come a long way, but it's growing and changing as companies and entrepreneurs continue to generate new ideas and technical concepts for potential commercial space transportation systems and related operations.

Mr. Chairman, this is the type of ingenuity and innovative spirit that defines our nation and our economic potential; and I want to see it succeed. I've said it before and I'll say it again, I want to fly as a passenger one day. However, Mr. Chairman, my enthusiasm is tempered by the recognition that there are number of questions about this growing industry that remain unanswered, and issues that need to be resolved. I raise them because they are questions of national policy and safety that deserve our due diligence and that help us, as Members of Congress, to fulfill our responsibilities to the American taxpayers.

Commercial space transportation, in fact, draws heavily on government support through contracts for launches, use of infrastructure, technical assistance, and financial support for the development of government-required transportation services. I want to recognize the significant taxpayer investments involved in supporting this industry as we consider any direction on policy or regulation.

Mr. Chairman, the recently passed extension of the third-party liability and indemnification regime for three years means that we have the time for a thoughtful examination of these questions, and I look forward to our Subcommittee conducting future hearings to address them. For example, should we be providing indemnification permanently or should we be laying the groundwork for a shift toward an insurance-based regime? How might such a transition occur and on what timeline? What would such a transition mean for the insurance industry? What other industry models should we examine?

There are also questions about how liabilities should be treated for passengers, or space flight participants as they are called. And that brings me to the question of whether the policy and regulations for commercial space flights with humans should differ from that for commercial launches carrying satellites, cargo or other payloads, which have comprised the commercial space launch industry to date. In short, is a "one-size-fits-all" approach to commercial space transportation policy and regulation appropriate? Or should we consider different frameworks for commercial human and commercial uncrewed space transportation systems?

Already, we are seeing the existing statute being tested by the evolving nature of the industry. For example, the current statute does not allow a commercial launch provider to hold a license on a launch vehicle design being used for paid flights, while also holding an experimental permit to test out improvements or modifications on another vehicle of the same design that is not being used for paid flights. This would seem to be something that could be remedied quickly through either legislative or administrative action, and I look forward to getting the FAA's thoughts on the matter at today's hearing.

In addition, when will Congress allow FAA to issue safety regulations for these new vehicles? I know that some in industry would like to put that date off for as long as possible. But, Mr. Chairman, we all know that spaceflight involves risk, and I don't think we should wait until there is an accident to put sensible safety regulations in place.

Finally, I also hope we can begin serious consideration of how we are going to handle accident investigation of commercial space launches, because we are getting closer to the day when humans will be flying on commercial suborbital, and eventually orbital systems. And when inevitably there is a "bad day," I don't think the government, the industry, or the families of those who might potentially be lost will benefit if we wind up developing an accident investigation framework under pressure and in reaction to a catastrophic event.

We have the opportunity and the time to thoughtfully consider what is needed to develop a structure for accident investigation, including the expertise that would be required and the data that industry should be collecting to facilitate a potential investigation, should an accident occur, and how other high-risk operations handle accident investigation.

Well, this is just a sample of questions that I hope we can explore with industry, government, academia and other stakeholders through hearings and dialogue, over at least the coming year, to inform what will be important legislation. So, let's not rush a bill, Mr. Chairman, when there are too many critical questions and issues that need our careful consideration. Let's take the time to get it right. I look forward to working with you to ensure the safety and success of the commercial space transportation industry.

Thank you, and I yield back the balance of my time.

Chairman PALAZZO. Thank you, Ms. Edwards.

I now recognize the Chairman of the full Committee for a statement.

Chairman SMITH. Thank you, Mr. Chairman.

Let me confess at the outset and say to the Ranking Member Donna Edwards that there are some days I wish she had laryngitis but today is actually not one of them. Furthermore, now that she is engaged to a Texan, I assume she will be voting with me more often.

Ms. EDWARDS. Mr. Chairman, that was not really public.

Chairman SMITH. Oh, well, I was looking at your engagement ring. I thought that was a giveaway. Sorry.

Ms. EDWARDS. In that case, thank you.

Chairman SMITH. We will scratch that for the record just for the—thank you, Mr. Chairman, for having this hearing. Also, I want to say we have excellent witnesses today.

Americans' record of ingenuity is filled with examples of entrepreneurs who pushed the boundaries of the possible. The commercial space industry relies on this same creative spirit. Three decades ago, Congress and President Reagan worked together to pass the Commercial Space Launch Act. This legislation paved the way for American entrepreneurs to reach for the stars.

America has always been a nation of innovators and explorers. We continue to remain on the forefront of new discoveries and technologies. Members of Congress were looking toward the future when they passed the Commercial Space Launch Act. They had the foresight to understand that space may not be the final frontier, but it is certainly the next frontier.

Were it not for this legislation, perhaps we would not have some of the modern conveniences that we take for granted today. The Space Subcommittee recently held a hearing with representatives of the commercial space industry. The message from those witnesses was clear. They need the government to be consistent in its policy and regulations need to allow them flexibility to develop their businesses and hire more American workers.

In 1984, there were 18 federal agencies involved in every launch. The system was inefficient and suffocated the industry. Congress passed the Commercial Space Launch Act to get government out of the way and reduce bureaucracy so American businesses could be innovative and develop. Perhaps we can continue to learn from that strategy.

Today, the Subcommittee will examine various aspects of the commercial space launch industry and how it is affected by the act. There are several provisions of the law that need to be updated, and the industry continues to evolve, so must the laws that govern it.

So, Mr. Chairman, I look forward to working with you and the Ranking Member and our friends on the other side of the aisle to draft a commercial space bill that will encourage the growth of the commercial space industry.

Before I yield to the gentleman from California, Mr. Rohrabacher, I would like to single out and recognize Stu Witt in the front row there, who is the Chairman of the Commercial Spaceflight Federation and is here from California. Stu, welcome to the hearing.

With that, Mr. Chairman, I will yield to the Vice Chairman of the full Committee, the gentleman from California, Mr. Rohrabacher.

[The prepared statement of Mr. Smith follows:]

PREPARED STATEMENT OF COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
CHAIRMAN LAMAR S. SMITH

Thank you Chairman Palazzo for holding this hearing. And I thank the witnesses for being here to share their expertise on this topic.

Americans' record of ingenuity is filled with examples of entrepreneurs who pushed the boundaries of the possible. The commercial space industry relies on this same creative spirit. Three decades ago, Congress and President Reagan worked to-

gether to pass the Commercial Space Launch Act. This legislation paved the way for American entrepreneurs to reach for the stars.

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In 1984, there were 18 federal agencies involved in every launch. The system was inefficient and suffocated the industry. Congress passed the Commercial Space Launch Act to get government out of the way and reduce bureaucracy so American businesses could be innovative and develop. Perhaps we can continue to learn from that wise strategy.

Today the subcommittee will examine various aspects of the commercial space launch industry and how it is affected by the act. There are several provisions of the law that need to be updated. As the industry continues to evolve, so must the laws that govern it.

As Chairman Palazzo pointed out, by working together we can develop bipartisan solutions to the various issues that face the commercial space sector.

I look forward to working with him and our friends on the other side of the aisle to draft a commercial space bill that will encourage the growth of the commercial space industry.

Thank you Mr. Chairman, I yield back.

Mr. ROHRABACHER. Thank you very much, and let me just note, as the author of the Commercial Space Launch Act of 2004, I would like to briefly touch on just three aspects of today's hearing, first, the regulatory learning period of commercial space regulations. Overcoming the challenges of creating and perfecting new space technologies has taken longer than we predicted ten years ago when we passed this act and we expected flights to begin much earlier than they actually have begun. What we should have done is structure this so the eight-year timeline started with the first commercial flight carrying a spaceflight participant. The most important point, however, is that we move forward, and that as we are moving forward, that regulating in the absence of actual flight data is the worst choice that we can make.

So item number two is the limits on testing of space vehicles once launch licenses have been issued. Virgin Galactic is continuing their powered test flights on SpaceShipTwo and the FAA is close to a decision on their license application. Their ability to complete their test programming, however, may be at risk once they have received the license. So I mean the last thing I can assure everyone here that we never intended a company's ability to test their vehicle or gather additional safety information to be limited simply because the license has been approved.

And finally, the current law indemnifies launch providers from claims above the insurance requirements but it also indemnifies government against the most probable claims in the case of an incident. This shared indemnification is important to both the government and the industry and we should make sure that we look at it as such.

And so I look forward to our hearing of our witnesses. I have to leave at three o'clock but I am really looking forward to your testimony and I may not be able to stay for the question period, but

thank you very much for yielding time and letting me put this on the record.

Chairman PALAZZO. Thank you. If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

Chairman PALAZZO. At this time, I would like to introduce our panel of witnesses. Our first witness is Dr. George Nield, Associate Administrator for Commercial Space Transportation at the Federal Aviation Administration. Dr. Nield came to the FAA from the Orbital Sciences Corporation where he served as senior scientist for the Advanced Programs Group. He was the manager of the Flight Integration Office for the Space Shuttle Program at Johnson Space Center, a graduate of the United States Air Force Academy. He holds an M.S. and Ph.D. in aeronautics and astronautics from Stanford University and an MBA from George Washington University.

Our second witness is Dr. Alicia Cackley, Director of the Financial Markets and Community Investment Team at the Government Accountability Office. She oversees policy research and program evaluation on a broad range of insurance, consumer protection, housing, and finance issues. Dr. Cackley received her Ph.D. in economics from the University of Michigan and has been with the GAO since 1990.

Our third witness is Dr. Henry Hertzfeld, Research Professor of Space Policy and International Affairs at the Elliott School of International Affairs at George Washington University. He is also an adjunct professor of law at GW. Dr. Hertzfeld has served as a senior economist and policy analyst at both NASA and the National Science Foundation and is a consultant to both U.S. and international agencies and organizations. Dr. Hertzfeld is a member of the bar in Pennsylvania and the District of Columbia. He received his Ph.D. from Temple University.

As our witnesses should know, spoken testimony is limited to five minutes each after which Members of the Committee have five minutes each to ask questions. Your written testimony will be included in the record of the hearing.

I now recognize our first witness, Dr. Nield, for five minutes.

**TESTIMONY OF DR. GEORGE NIELD,
ASSOCIATE ADMINISTRATOR FOR COMMERCIAL
SPACE TRANSPORTATION, FEDERAL AVIATION
ADMINISTRATION**

Dr. NIELD. Chairman Palazzo, Ranking Member Edwards, and distinguished Members of the Subcommittee, thank you for inviting me to speak with you today. This is an exciting time for commercial space transportation, and I appreciate having the opportunity to provide you with an update.

Since I last testified before the Subcommittee in 2012, the level of commercial space transportation activity in the United States has increased significantly. For example, in Fiscal Year 2012 there were only three FAA licensed or permitted launches. In Fiscal Year 2013 there were 18, a sixfold increase.

The prospects for continued growth are solid. Both SpaceX and Orbital Sciences Corporation are now conducting launches under

FAA licenses in order to deliver supplies to our astronauts onboard the International Space Station. Sierra Nevada Corporation, Boeing, and SpaceX are all developing systems to carry NASA astronauts to and from the Space Station as part of NASA's Commercial Crew Program. The development of suborbital vehicles is also continuing with a number of flight tests expected during the coming year.

Virgin Galactic and XCOR Aerospace have signed up nearly 1,000 potential participants, yet space tourism is just the tip of the iceberg. Potential suborbital missions include conducting scientific research, demonstrating new technologies, media and public relations, educational outreach, and satellite deployment. New ideas and plans are coming our way with increasing frequency. Right now, we have about 25 ongoing pre-application consultations. This number includes proposals for new vehicles, new spaceports, safety approvals, and requests for payload reviews. All of these indicators are signs of industry growth.

The FAA Office of Commercial Space Transportation has a two-fold mission: To ensure protection of the public, property, and the national security and foreign-policy interests of the United States during commercial launch and reentry activities; and to encourage, facilitate, and promote commercial space transportation. To carry out our safety responsibilities, we develop and issue regulations, grant licenses, permits, and safety approvals, and conduct safety inspections during every licensed or permitted launch.

With the advent of on-orbit commercial space transportation, the FAA has begun a dialogue with our stakeholders to explore the need for adjustments to the FAA's statutory authority. As the number of commercial space transportation vehicles increases, it is appropriate to consider closing the current regulatory and safety gap between launch and reentry. The FAA believes it is time to explore the orbital safety of commercial space transportation under the Commercial Space Launch Act licensing regime.

As the popular film *Gravity* was able to illustrate so dramatically, collisions in space can have devastating effects. The FAA's experience with collision avoidance includes conducting analyses and implementing orbital debris mitigation practices for U.S. licensed launches. The National Space Transportation Policy, which was issued in November of 2013, calls on the FAA to execute exclusive authority in this area. Should the FAA's authority be increased, we would work to ensure that appropriate levels of orbital safety are maintained in addition to our responsibility for launches and reentries. The goal would be for the FAA to address orbital transportation safety, including for orbital debris mitigation, for spacecraft whose primary function was transportation.

Finally, I would like to assure the Subcommittee that our partnership with NASA with respect to its commercial activities is proceeding very smoothly. We strongly support the Administration's requested changes for the Commercial Space Launch Act that would add a third category of occupants called government astronauts. The changes would complement our existing definitions of crew and spaceflight participants, and would increase transparency and ease the administration of our regulations in the context of NASA astronauts serving as crew.

Mr. Chairman, this concludes my prepared remarks. I will be pleased to answer any questions that you may have.
[The prepared statement of Dr. Nield follows:]

STATEMENT OF DR. GEORGE C. NIELD, ASSOCIATE ADMINISTRATOR FOR
COMMERCIAL SPACE TRANSPORTATION OF THE FEDERAL AVIATION
ADMINISTRATION, BEFORE THE HOUSE COMMITTEE ON SCIENCE, SPACE,
AND TECHNOLOGY, SUBCOMMITTEE ON SPACE, ON NECESSARY UPDATES
TO THE COMMERCIAL SPACE LAUNCH ACT, FEBRUARY 4, 2014.

Chairman Palazzo, Ranking Member Edwards, and Distinguished Members of the
Subcommittee:

Thank you for inviting me to speak with you today. Since I last testified before the
Subcommittee in 2012, United States commercial space transportation activity has
increased significantly, and operations have become more advanced. In Fiscal Year
2013, launches licensed and permitted by the FAA grew six-fold over FY 2012 to a total
of 18. Just last month, three commercial launches took place within the week of January
6 – 10, with missions by SpaceX, Orbital Sciences Corporation, and a suborbital flight
test of SpaceShipTwo by Scaled Composites. This equaled the number of licensed and
permitted launches in FY 2012. The prospects for continued growth are solid. For
example, SpaceX has nearly 50 committed launches on its manifest.

SpaceX's Dragon and Orbital Sciences' Cygnus successfully demonstrated Commercial
Resupply Services (CRS) to the International Space Station for NASA. SpaceX plans to
conduct a third CRS mission this month. SpaceX also launched its first mission to
geosynchronous orbit in December 2013.

Sierra Nevada, Boeing, and SpaceX are developing new vehicles to carry people to and
from the International Space Station in competition for NASA's Commercial Crew
Program. Bigelow Aerospace has entered into a Space Act Agreement with NASA to

connect its expandable activity module (BEAM) to the International Space Station next year. BEAM will be transported to the International Space Station by SpaceX's Dragon, and will join the two Bigelow demonstration habitats already on-orbit.

Suborbital activities will include continued testing, and more flights are planned for this year. Virgin Galactic and XCOR Aerospace have signed up nearly one thousand potential participants. Yet, space tourism is just the tip of the iceberg. Potential suborbital missions include training, aerospace technology testing, media and public relations uses, educational outreach, and satellite deployment. New ideas and plans come our way with increasing frequency. The FAA Office of Commercial Space Transportation has about 25 on-going "pre-application consultations." This number includes proposals for new vehicles, new spaceports, safety approvals and requests for payload reviews. All of these indicators are a sign of U.S. industry growth.

Progress brings challenges. The November 2013 National Space Transportation Policy (NSTP) reaffirmed the Administration's continued commitment to maintain America's competitiveness in the aerospace sector to ensure the United States will stay on the cutting edge by maintaining space transportation capabilities that are innovative, reliable, efficient, competitive, and affordable and that support U.S. interests. Maintaining an assured capability to meet U.S. Government needs, while also taking the necessary steps to strengthen U.S. competitiveness in the international commercial launch market is important to ensuring that U.S. space transportation capabilities will be reliable, robust, safe, and affordable in the future. Securing public safety in commercial space

transportation is a vital FAA mission. The viability of commercial space transportation depends on safety, as do all activities in Earth's orbit, as well as the prospects of continued safe access to space.

Orbital Transportation Safety

The FAA has begun a dialogue with its stakeholders to explore the need for adjustments to the FAA's statutory authority with the advent of commercial on-orbit space transportation. Cargo delivery to the ISS by SpaceX's Dragon and Orbital Sciences' Cygnus is now done by private industry. Capabilities continue to advance. As the prospects for a greater number of commercial transportation vehicles in space increase, it is time to consider closing the current regulatory and safety gap between launch and reentry.

Everything on orbit is in motion. The complex environment of Earth's orbit includes spacecraft, satellites, and orbital debris traveling at hyper-velocities. On average, collisions in low Earth orbit (LEO) occur at a closure rate of over 22,000 miles per hour. Collisions between orbital debris, satellites and spacecraft pose serious safety risks to persons and property in space and the safe operations of orbital systems. Collisions can lead to an exponential increase in space debris, increasing the threat to other operations.

For example, in 2009, the collision between a U.S.-based satellite and a Russian satellite was followed by a measurable increase in tracked orbital debris. Debris from the event

was estimated to remain in orbit for years to come. NASA reported that in October 2013 over 800 cataloged objects, including 10 percent spacecraft, one-third rocket bodies, and the rest miscellaneous debris, posed a potential threat to the International Space Station. This represented a 60 percent increase from the number of tracked objects that were viewed as a potential threat to the Space Station in November 1998. The continued generation of debris threatens the long-term sustainability of space and creates an immediate risk to manned and unmanned space operations. As space capabilities continue to advance, and as the prospects for a greater number of objects in space increase, certainty in planning for collision avoidance on-orbit becomes ever more critical.

The FAA believes it is time to explore orbital safety of commercial space transportation under the Commercial Space Launch Act licensing regime. The FAA's experience with collision avoidance includes conducting analysis and implementing orbital debris mitigation practices consistent with international standards, but these are limited to commercial launch and reentry activities. The NSTP recognizes the importance of the FAA's responsibility to execute exclusive authority in this area, and we are committed to carrying out the policy and ensuring the safety of launch and reentry. We work with launch and reentry operators on a daily basis. We conduct payload reviews to determine whether the payload complies with all requirements of United States law related to launching or reentering the payload, and that all licenses, authorizations, or permits are obtained for the payload, or that it is otherwise safe. Should the FAA authority be increased, we would work to ensure appropriate levels of orbital safety are maintained in

addition to our responsibilities of licensing launch and reentry. The goal would be for the FAA to address orbital transportation safety, including for orbital debris mitigation, for spacecraft whose primary function was transportation.

In November 2013 the FAA Administrator publicly recognized the impacts increased commercial space activities will have on the National Airspace System (NAS). The FAA is working to improve the facilitation and integration of space operations into NAS planning. Increased certainty and capability to assess and manage on-orbit safety would also facilitate NAS planning. Finally, assigning an Agency on-orbit authority would also help protect the U.S. Government from liability exposure, just as it is now protected during FAA licensed launches.

International Outreach

An increasing number of foreign countries are developing and improving space capabilities. This will contribute to increases of foreign space activity, some of which may occur in orbit. Foreign efforts include commercial space transportation activities and opportunities. Some countries are developing spaceports to accommodate potential U.S. and international suborbital vehicles. Others are interested in privatizing existing expendable launch vehicles and enabling oversight of commercial activities. With this activity, other countries are looking to develop their own laws and regulations governing in space travel. As leaders in commercial space, we must engage with the international community and shape international standards to improve safety.

The 2013 National Space Transportation policy instructs the Secretary of Transportation and other appropriate department and agency heads to advocate internationally for the adoption of United States Government safety regulations, standards, and licensing measures to enhance global interoperability and safety of international commercial space transportation activities. This builds on similar guidance from the 2010 National Space Policy. Enhancing global leadership in safety is a priority of the FAA Administrator.

As the U.S. space transportation industry began to market suborbital services internationally, the Office of Commercial Space Transportation created an international outreach program to promote the adoption of U.S. commercial space transportation regulatory approach. The goals of this program are to: 1) assist U.S. industry activity outside the United States, 2) provide U.S. international leadership, 3) establish international relationships, and 4) prepare for future interoperability between countries. To that end, the FAA has met and discussed in detail U.S. law and FAA regulations with representatives from nations across the globe.

Through our international outreach, we have found that the FAA Office of Commercial Space Transportation is unique. However, we do not have the only approach in commercial space transportation safety. A lot of work lies ahead as we increase cooperation with other countries and multi-national entities. We hope that in the future, as the industry develops new capabilities, that our efforts in these new areas will serve as models for the rest of the world to adopt.

Benefit of Continued Certainty

Last month's reauthorization of the provision for the conditional payment of excess third-party claims by the United States Government through 2016 will benefit U.S. industry by putting U.S. companies on a more equal footing with international competitors that offer indemnification. In accordance with the 2013 NSTP, the FAA supports the continuation of the current liability risk-sharing regime for U.S. commercial space transportation activities. Increased certainty over the integrity of the liability risk-sharing regime is integral to long-term planning, particularly by potential customers that must plan years in advance of launch.

Finally, we wanted to let the subcommittee know that our partnership with NASA on its commercial activities is proceeding very smoothly. We strongly support the Administration's requested changes to the Commercial Space Launch Act that would add a third category of occupants called government astronauts. The changes would complement our existing definitions of crew and spaceflight participants, and would increase transparency and ease the administration of our regulations in the context of NASA astronauts serving as crew.

Mr. Chairman, this concludes my prepared remarks. I would be pleased to answer any questions you may have.

DR. GEORGE C. NIELD

Associate Administrator for Commercial Space Transportation



Dr. George C. Nield serves as the Associate Administrator for Commercial Space Transportation at the FAA. He has over 30 years of aerospace experience with the Air Force, at NASA, and in private industry. Dr. Nield came to the FAA from the Orbital Sciences Corporation, where he served as Senior Scientist for the Advanced Programs Group. His previous assignments include working as an Astronautical Engineer at the Space and Missile Systems Organization, a Flight Test Engineer at the Air Force Flight Test Center, and an Assistant Professor and Research Director at the USAF Academy. He was the Manager of the Flight Integration Office for the Space Shuttle Program at the NASA Johnson Space Center, and later worked on both the Shuttle/Mir Program and the International Space Station Program. He was recently appointed by the NASA Administrator to serve on the Aerospace Safety Advisory Panel (ASAP). A graduate of the United States Air Force Academy, he holds an M.S. and Ph.D. in Aeronautics and Astronautics from Stanford University, and an MBA from George Washington University. He is also a Flight Test Engineering graduate of the USAF Test Pilot School. Dr. Nield is a registered Professional Engineer and a Fellow of the American Institute of Aeronautics and Astronautics.

Chairman PALAZZO. Thank you, Dr. Nield.
I now recognize our next witness, Dr. Cackley, for five minutes.

**TESTIMONY OF DR. ALICIA CACKLEY,
DIRECTOR OF FINANCIAL MARKETS AND
COMMUNITY INVESTMENT TEAM,
GOVERNMENT ACCOUNTABILITY OFFICE**

Dr. CACKLEY. Chairman Palazzo, Ranking Member Edwards, and Members of the Subcommittee, I am pleased to be here today to talk about the Federal Aviation Administration's Commercial Space Launch Indemnification Program.

As you are aware, a catastrophic commercial launch accident could have a significant impact on the uninvolved public or third parties in the form of personal injuries or property damage. In anticipation of such an event, a launch company must purchase a fixed amount of insurance for each launch per calculation by the FAA. According to the 1988 amendments of the Commercial Space Launch Act, or CSLA, the federal government is then potentially liable for claims above that amount up to an additional \$3 billion as adjusted for inflation and subject to Congressional appropriations.

My statement today is based on work that we completed in July of 2012 at the request of this Committee and the Senate Committee on Commerce, Science, and Transportation, with some updates as of January 2014 of FAA launch data and insurance industry capacity, as well as FAA's progress on implementing our recommendation.

In July 2012 we compared the U.S. Government's indemnification policy with those of other countries and found that the United States provides less indemnification for third-party losses than key competitors such as China, France, and Russia because these countries put no upper limit on the amount of their coverage, while in the United States, coverage stops at about \$3 billion per launch. However, for a given launch, the point at which the U.S. Government starts to cover losses, the maximum probable loss, may be lower than in other countries.

In all these countries, including the United States, these commitments to pay have never been tested because there has never been a third-party claim that exceeded the launch companies' insurance and thus reached the level of government indemnification. As a result, the potential cost to the federal government of indemnification for third-party losses is unclear. Estimating probable losses from a rare catastrophic event is difficult, but how accurate that calculation is depends on the soundness of the methodology that generates it.

In July 2012, insurance industry officials and risk modeling experts told us that FAA's method of calculating maximum probable loss was outdated, had not been reviewed by outside experts, and may not be sound. An inaccurate calculation that understates the amount of insurance a launch provider must obtain would increase the likelihood of cost to the federal government and lower insurers' cost, whereas a calculation that overstates the amount of insurance would decrease the likelihood of federal costs and raise insurers' costs. In addition, the possible growth in commercial launches, in-

cluding manned launches, could increase the number of launches eligible for CSLA coverage and thus potential costs for the federal government.

In July 2012, FAA officials said that their method for calculating maximum probable loss was reasonable and conservative but they agreed that a review could be beneficial and that involvement of outside experts might be helpful for improving their methodology. In January 2014, FAA told us they have taken some initial steps toward revising and updating their maximal probable loss methodology but that budget constraints had prevented further progress in the short term. We continue to believe that our July 2012 recommendation that FAA periodically review and update as appropriate its methodology for calculating launch providers' insurance requirements has merit and should be fully implemented.

With respect to the ability and willingness of the insurance market to provide additional third-party liability coverage, industry representatives we contacted in July 2012 told us the market was generally willing and able to provide up to \$500 million per launch, and one insurer recently confirmed this is still the case. Because the amount of insurance FAA requires launch providers to obtain averages about \$82 million per launch as of 2014 and coverage available through CSLA is about \$3 billion above a given launch's maximum probable loss, insurers could provide some of the coverage currently available through CSLA, namely, the difference between the maximum probable loss and the \$500 million the industry indicated was the most they might provide. However, industry representatives cautioned that the amount and price of insurance that they might provide could change quickly if a large loss were to occur. If those costs are passed on to customers, U.S. launch companies could be more expensive and therefore less competitive than their foreign counterparts.

Oh, I am sorry. Let me start this last part over.

Finally, while ending indemnification could potentially decrease U.S. competitiveness, this depends on many factors and the actual effects are currently unknown. Launch companies and customers GAO contacted in July 2012 believe that ending federal indemnification could lead to higher launch costs for U.S. launch companies. If those costs are passed on to customers, U.S. launch companies could be more expensive, and therefore, less competitive than their foreign counterparts. However, it is unclear exactly how much the cost of third-party liability insurance, which brokers told us is about one percent of the total insurance coverage purchased by launch companies, might increase in the absence of federal coverage. And while launch customers said that price and vehicle reliability were key factors in their choice of a launch company, it is also not clear whether the increase in insurance costs alone would be sufficient reason for a launch customer to choose a foreign launch company over a U.S. company.

Mr. Chairman, this concludes my prepared statement. I would be happy to respond to any questions.

[The prepared statement of Dr. Cackley follows:]



United States Government Accountability Office

Testimony
Before the Subcommittee on Space,
Committee on Science, Space, and
Technology, House of Representatives

For Release on Delivery
Expected at 2:00 p.m. EST
February 4, 2014

COMMERCIAL SPACE LAUNCHES

FAA's Risk Assessment Process Is Not Yet Updated

Statement of Alicia Puente Cackley, Director,
Financial Markets and Community Investment

Chairman Palazzo, Ranking Member Edwards, and Members of the Subcommittee:

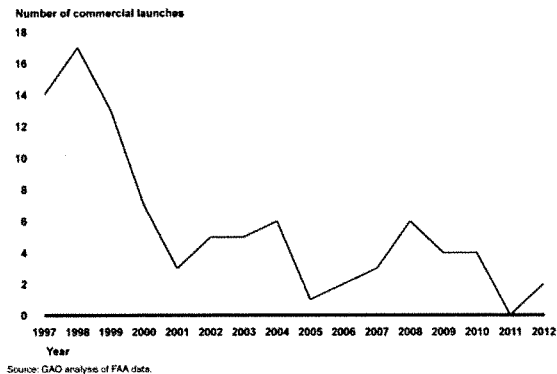
Thank you very much for the opportunity to testify today on commercial space launch indemnification as you consider the future of the federal role in this area. The Commercial Space Launch Act Amendments of 1988¹ amended the Commercial Space Launch Act (CSLA)² and provides federal indemnification of third party damages resulting from commercial space launches and have recently been reauthorized until the end of 2016. This legislation made the federal government responsible, subject to an appropriation provided by Congress, for a portion of third party liability claims that arise from a catastrophic launch-related incident that results in injury or damage to uninvolved people or property.³ The goal was to provide a competitive environment for the U.S. commercial space launch industry by providing, among other things, government indemnity while still minimizing the cost to taxpayers. As figure 1 shows, although the number of U.S. commercial launches, which are licensed by the Federal Aviation Administration (FAA), has generally declined since its peak of 17 in 1998, two launches occurred in 2012 which were procured by the National Aeronautics and Space Administration (NASA) as part of their commercial cargo transportation services to the International Space Station (ISS). NASA also intends to procure commercial manned launches to carry its astronauts to the ISS beginning in 2017. In addition, a number of companies are developing new launch vehicles that could provide these orbital services. Other companies are developing suborbital vehicles that could carry passengers for space tourism flights.

¹Pub. L. No. 100-657, 102 Stat. 3903 (1988).

²Commercial Space Launch Act, Pub. L. No. 98-575, 98 Stat. 3055 (1984).

³51 U.S.C. § 50915.

Figure 1: Annual Number of Commercial U.S. Space Launches, 1997-2012



This statement is based primarily on a July 2012 report we completed at the request of this committee and the Senate Committee on Commerce, Science, and Transportation and related updates we conducted in January 2014 by reviewing FAA launch data and speaking with FAA officials as well as a commercial space launch insurance industry representative. This statement discusses (1) the U.S. government's indemnification policy compared to policies of other countries, (2) the federal government's potential costs for indemnification, (3) the ability and willingness of the insurance market to provide additional coverage, and (4) the effects of ending indemnification on the competitiveness of U.S. launch companies. For the 2012 report, we reviewed launch data from FAA and performed a literature search. We also reviewed documents from and conducted interviews with insurance brokers and underwriters who provide commercial launch companies with coverage for third party liability, experts in commercial space launch liability issues and risk management, representatives from launch companies and customers, and officials from FAA and NASA. Additional information on our methodology is provided in our July 2012 report.

The work upon which this testimony was based was conducted in accordance with generally accepted government auditing standards.

Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

U.S. Indemnification Policy The 1988 amendments to CSLA established the current U.S. policy to provide federal payment, subject to appropriations—known as indemnification—for a portion of claims by third parties for injury, damage, or loss that result from a commercial launch-related incident.⁴ All FAA-licensed commercial launches and reentries by U.S. companies, whether unmanned or manned and from the United States or overseas, are covered by federal indemnification for third party damages that result from the launch or reentries.⁵ Parties involved in launches—for example, passengers and crew—are not eligible for indemnification coverage.⁶

U.S. indemnification policy has a three-tier approach for sharing liability between the government and the private sector to cover third party claims:

- The first tier of coverage is the responsibility of the launch company and is handled under an insurance policy purchased by the launch company. As part of FAA's process for issuing a license for a commercial launch or landing, the agency determines the amount of third party liability insurance a launch company is required to purchase so the launch company can compensate third parties for any claims for damages that occur as a result of activities carried out under the license.⁷ FAA calculates the insurance amount to reflect the

⁴51 U.S.C. § 50915.

⁵51 U.S.C. § 50914(a)(1)(A).

⁶A crew includes any employee who performs activities directly relating to the launch, reentry, or other operation relating to the vehicle that carries human beings. 51 U.S.C. § 50902(2). A passenger—also called a spaceflight participant—is an individual who is not crew, carried aboard a launch vehicle or reentry vehicle. 51 U.S.C. § 50902(17).

⁷14 C.F.R. § 440.9.

maximum probable loss that is likely to occur because of an accident that results in third party damages, including deaths and injuries on the ground and damage to property from spacecraft debris.⁸ FAA uses a statistical approach to estimate expected losses based on estimated probabilities that a catastrophic incident could occur and the estimated costs of a catastrophic incident given the details of the specific launch. This first tier of required insurance coverage is capped at a maximum of \$500 million for third party damages.⁹

- The second tier of coverage is provided by the U.S. government, and it covers any third party claims in excess of the specific first tier amount up to a limit of \$1.5 billion adjusted for post-1988 inflation; in 2013, the inflation-adjusted amount was approximately \$3 billion.¹⁰ For the federal government to be liable for these claims, Congress would need to appropriate funds. This second tier of coverage will expire in December 2016 unless Congress extends this date.¹¹ (The other two tiers have no expiration date.)
- The third tier of coverage is for third party claims in excess of the second tier—that is, the federal coverage of \$1.5 billion above the first tier, adjusted for inflation. Like the first tier, this third tier is the responsibility of the launch company, which may seek insurance above the required first tier amount for this coverage. Unlike the first tier, no insurance is required under federal law.

Another component of U.S. indemnification policy for commercial space launches and reentries is cross waivers. They provide that each party involved in a launch (such as the launch company, the spacecraft manufacturer, and the customer) agrees not to bring claims against the other parties and assumes financial responsibility for damage to its own

⁸FAA makes this determination for each space launch by reviewing the specific circumstances of the launch, including the planned launch vehicle, launch site, payload or cargo, flight path, and the potential casualties and fatalities that could result from varying types of launch failures at different points along that path. FAA estimates the total cost of estimated casualties from a launch failure and uses this information as the basis for determining property damage.

⁹51 U.S.C. § 50914(a)(3)(A)(i).

¹⁰51 U.S.C. § 50915(a)(1).

¹¹51 U.S.C. § 50915(f).

property or loss or injury sustained by its own employees.¹² Cross waivers also do not have an expiration date.

According to FAA, no FAA-licensed commercial space launch since 1989 has resulted in casualties or substantial property damage to third parties. In the event of a third party claim that exceeded the launch provider's first-tier coverage, FAA would be involved in any negotiations, according to FAA officials, and the Secretary of Transportation must approve any settlement.¹³

**Global Commercial Space
Launch Industry**

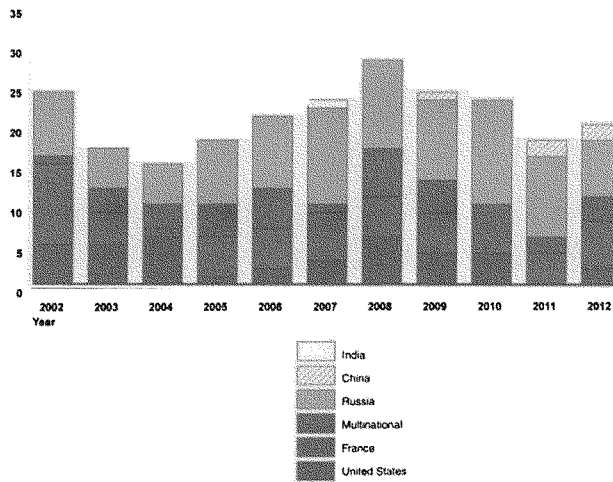
From 2002 through 2012, U.S. companies conducted approximately 16 percent of commercial space launches worldwide, while Russia conducted 42 percent and France's launch company conducted 25 percent. Figure 2 shows the trend in number of commercial space launches over the last 11 years.

¹²51 U.S.C. § 50914(a)(4).

¹³51 U.S.C. § 50915(b)(3).

Figure 2: Number of Commercial Space Launches Worldwide, 2002-2012

Number of commercial orbital launches



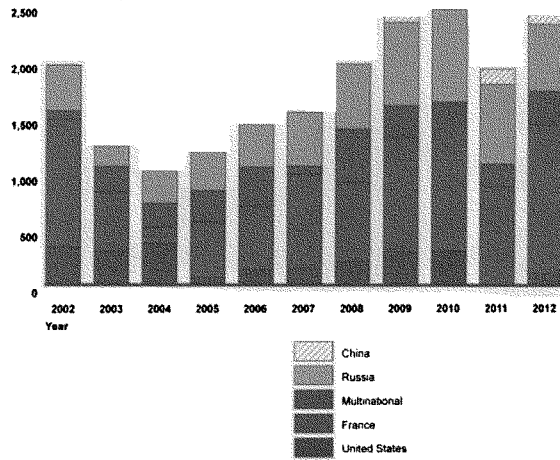
Source: GAO analysis of FAA data.

Note: The multinational launches include Sea Launch, a multinational consortium that is licensed by FAA because one of its principals is a U.S. company.

Over the past several years Russian and French launches have generated the most revenues, followed by U.S. launches. In 9 of the last 11 years, U.S. commercial launch companies generated less revenue than launches in either Russia or France. U.S. companies generated no commercial launch revenue in 2011 because they conducted no launches. (See fig. 3.)

Figure 3: Commercial Space Launch Revenues Worldwide, 2002-2012

Commercial revenue (dollars in millions)



Source: GAO analysis of FAA data.

Note: India is not included in this figure due to its small amount of revenues.

The United States Provides Less Liability Coverage Than Foreign Competitors Due to a Cap on Government Indemnification

As of July 2012, the United States provided less total third party liability coverage than China, France, or Russia—the primary countries that have conducted commercial space launches in the last 5 years—according to published reports.¹⁴ These countries each had an indemnification regime in which the government states that it will assume a greater share of the risk compared to that of the United States because each country had a two-tiered system with no limit on the amount of government indemnification. By comparison, the United States caps government indemnification at \$1.5 billion adjusted for inflation beyond the first-tier insurance amount. However, U.S. government coverage, in some cases, begins at a lower level than that of the other countries because U.S. coverage begins above the maximum probable loss, which averaged about \$82 million for active FAA launch and reentry licenses as of 2012, and ranged from about \$3 million to \$267 million. The level at which government coverage begins for the other three countries ranged from \$79 million to \$300 million.

China, France, and Russia had a first tier of insurance coverage that a commercial launch company must obtain, similar to the United States. The second tier of government indemnification varied for these countries:

- The Chinese government provided indemnification for third party claims over \$100 million.
- The French government provided indemnification for third party claims over 60 million euros (about \$75 million as of May 2012).
- The Russian government provided indemnification for third party claims over \$80 million for the smaller Start launch vehicles and \$300 million for the larger Soyuz and Proton vehicles.¹⁵

For all these countries, their commitments to pay have never been tested. Globally, there has never been a third party claim for damages from a

¹⁴In addition, India conducted one commercial space launch during this period, but we found conflicting information on the Indian government's indemnification coverage, and therefore we are not including it in this discussion.

¹⁵The source for all the government amounts is Aerospace Corporation, *Study of the Liability Risk-Sharing Regime in the United States for Commercial Space Transportation* (El Segundo, Calif.: August 2006) or FAA, *Liability Risk-Sharing Regime for U.S. Commercial Space Transportation: Study and Analysis* (Washington, D.C.: April 2002).

commercial space launch failure that reached second-tier government coverage.

**Potential Cost of
Indemnification by the
Federal Government
Depends on a Variety
of Factors**

**Catastrophic Events and
Congressional
Appropriations**

The federal government's potential costs under CSLA depend on (1) the occurrence of a catastrophic launch failure with third party claims that exceed the first tier of coverage and (2) Congress appropriating funds to cover the government's liability under the second tier of coverage. FAA officials stated that no FAA-licensed commercial space launches or reentries have resulted in casualties or substantial property damage to third parties. As a result, FAA believed that it is highly unlikely that there will be any costs to the federal government under CSLA. In the event that a catastrophic failure did occur, FAA's maximum probable loss calculation was intended to estimate the maximum losses likely to occur from a commercial space launch and determine the amount of third party losses against which launch companies must protect. In calculating maximum probable loss, FAA aimed to include estimates of losses from events having greater than a 1 in 10 million chance of occurring, meaning that losses are very unlikely to exceed launch companies' private insurance and become potential costs for the government under CSLA.

Under CSLA, if a rare catastrophic event were to occur which resulted in losses exceeding private insurance coverage, the government would be responsible for paying claims that exceeded FAA's maximum probable loss only if Congress provided appropriations for this purpose. Under CSLA, the federal government does not incur a legal liability unless an appropriation is made for this purpose.¹⁶ Accordingly, an obligation would

¹⁶CSLA requires the Secretary of Transportation to provide for the payment of specific types of successful third party claims to the extent provided in advance in an appropriation act or to the extent additional legislative authority is enacted providing for paying for claims in a compensation plan submitted to Congress by the President. 51 U.S.C. § 50915 (a)(1).

not be recorded in the federal budget unless and until such an appropriation is made. While an obligation is not incurred or recorded for potential CSLA losses until an appropriation is provided, some insurance companies told us that they expect the government to pay losses that become eligible for coverage under CSLA.

**Maximum Probable Loss
Soundness**

While it is very difficult to assess catastrophic failures that have low probabilities but potentially high losses, FAA's use of an appropriate process for determining the maximum probable loss is important because the maximum probable loss sets the point at which losses become potential costs to the government under CSLA. For our July 2012 report, we identified several issues that raised questions about the soundness of FAA's maximum probable loss methodology:

- FAA used a figure of \$3 million when estimating the cost of a single potential casualty—that includes either injury or death—which FAA officials said had not been updated since they began using it in 1988. Two insurers, as well as representatives of two companies that specialize in estimating damages from catastrophic events (modeling companies), said that this figure is likely understated. Because this number had not been adjusted for inflation or updated in other ways, it may not adequately represent the current cost of injury or death caused by commercial space launch failures. Having a reasonable casualty estimate can affect FAA's maximum probable loss calculation and could affect the potential cost to the government from third party claims.
- FAA's methodology for determining potential property damage from a commercial space launch started with the total cost of casualties and added a flat 50 percent to that cost as the estimate of property damage, rather than specifically analyzing the number and value of properties that could be affected in the event of a launch failure. One insurer and two risk modelers said that FAA's approach is unusual and generally not used to estimate potential losses from catastrophic events. For example, officials from both modeling companies noted that the more common approach is to model the property losses first and derive the casualty estimates from the estimated property losses. For example, if a property loss scenario involves the collapse of a building, that scenario would have a different casualty expectation than a scenario that did not involve such a collapse. One modeler stated that FAA's method might significantly understate the number of potential casualties, noting that an event that has a less than 1 in 10

million chance of occurring is likely to involve significantly more casualties than predicted under FAA's approach. Moreover, a 2007 FAA review conducted with outside consultants said that this approach is not recommended because of observed instances where casualties were low yet forecasted property losses were very large.¹⁷

- More broadly, FAA's method did not incorporate what is known in the insurance industry as "catastrophe modeling." One modeler told us that catastrophe modeling has matured over the last 25 years—as a result of better data, more scientific research, and advances in computing—and has become standard practice in the insurance and reinsurance industries.¹⁸ Catastrophe models consist of two components: a computer program that mathematically simulates the type of event being insured against and a highly detailed database of properties that could potentially be exposed to loss. Tens of thousands or more computer simulations are generated to create a distribution of potential losses and the simulated probability of different levels of loss.¹⁹ In contrast, FAA's method involves estimating a single loss scenario.

FAA officials told us that they had considered the possibility of using a catastrophe model. However, they expressed concern about whether the more sophisticated approach would be more accurate, given the great uncertainty about the assumptions, such as the probability and size of potential damages that must be made with any model. Also, industry experts told us that a significant cost factor in catastrophe modeling is creating and maintaining a detailed database of exposed properties. One expert told us that in order for FAA to do such modeling, it would need to purchase a property exposure database, which could cost hundreds of thousands of dollars. Experts also disagreed on how feasible it would be to mathematically model the potential damages associated with space launches. One expert thought such modeling would not be credible

¹⁷For more information on FAA's methodology, see J.D. Collins, C.P. Brinkman, and C.L. Carbon, ACTA Inc., and FAA, *Determination of Maximum Probable Loss* (2007).

¹⁸Reinsurance is essentially insurance for insurers—that is, insurance companies buy coverage for all or a part of a policy's liability from other insurers in order to offset exposure.

¹⁹The probability distribution of losses is typically presented in what is known as an exceedance probability curve, which shows the probability of losses exceeding various levels.

because the necessary knowledge of the factors that can influence a space launch is not at the same level as the more developed research for modeling hurricanes, for example. Another expert thought that it would be possible to develop credible space launch simulation models. Another expert stated that such models have not been developed to date because of the government-provided indemnity coverage; this expert believed that if such coverage were the responsibility of the private sector, the necessary models might be developed.

FAA officials also said that they believed the maximum probable loss methodology is reasonable and produces conservative results for several reasons. First, FAA officials described a 2002 study on aviation casualty costs to support its use of a \$3 million casualty figure for its calculation. Use of a casualty estimate that is based on 2002 data, however, still raises questions about whether this figure is outdated, which could result in underestimating the cost of casualties. Second, to support basing the potential cost of property damage on the potential cost of casualties, FAA officials said that they have conducted internal analyses using alternative methodologies—including some that assessed property values in the vicinity of launches—and compared them to their current methodology. In each case, officials said that the current methodology produced higher, or more conservative, maximum probable losses. We were unable to review or verify these analyses, however, because FAA officials said that these analyses were done informally and were not documented.

FAA officials acknowledged that updating the \$3 million casualty figure and conducting analyses of potential property damage (rather than using a casualty cost adjustment factor of 50 percent) might produce more precise estimates of maximum probable losses. However, they said that because the probabilities assigned to such losses are still rough estimates, whether taking these actions would increase the accuracy of their maximum probable loss calculations is uncertain. Overall, they said, use of more sophisticated methodologies would have to be balanced with the additional costs to both FAA and the launch companies that would result from requiring and analyzing additional data. For example, a new methodology might require either FAA or the launch company to gather current property information, and might necessitate that FAA construct a statistical model for analyzing potential losses.

The same officials noted that they periodically evaluated their current maximum probable loss methodology, but acknowledged that they have not used outside experts or risk modelers for this purpose. They agreed that such a review could be beneficial, and that involvement of outside

experts might be helpful for improving their maximum probable loss methodology. FAA's 2007 review of potential alternatives identified a number of criteria for a sound maximum probable loss methodology that could be useful in such a review. These included, among other things, that the process use a valid risk analysis, be logical and lead to a rational conclusion, and avoid being overly conservative or under conservative. A sound maximum probable loss calculation can be beneficial to both the government and launch companies because it can help ensure that the government is not exposed to greater costs than intended (such as might occur through an understated maximum probable loss) and help ensure that launch companies are not required to purchase more insurance coverage than necessary (such as might occur through an overstated maximum probable loss).

In our July 2012 report, we recommended that FAA take steps to better ensure the accuracy of the process it uses to determine amount of insurance coverage required for an FAA launch license by reviewing and periodically reassessing its maximum probable loss methodology—including the reasonableness of the assumptions used. For these reviews, we recommended that FAA consider using external experts such as risk modelers, document the outcomes, and adjust the methodology, as appropriate, considering the costs. In January 2014, FAA officials told us about their recent efforts to reassess the methodology. First, officials have begun to implement an internal effort to develop an improved methodology for determining maximum probable loss. While budget constraints limited progress in 2013 to work with a contractor on the new methodology, the passage of the Consolidated Appropriations Act of 2014 in January 2014 provides FAA with resources to fund the effort which they say they intend to do beginning in March 2014. Second, FAA solicited input from FAA's Commercial Space Transportation Advisory Committee on how to best conduct an external review of their methodology. In January 2014, FAA officials said they held an initial meeting in January 2013 to begin this process, but as of January 2014, they still did not have funds available to solicit an outside review.

**Current Private
Market Capacity for
Coverage Is
Generally \$500
Million per Launch,
but a Large Loss
Could Decrease
Capacity**

Private Capacity

In our prior review, some insurers and brokers suggested that the maximum amount of private sector third party liability coverage the industry is currently willing to provide was generally around \$500 million per launch. This amount, or capacity, is determined by the amount of their own capital that individual insurers are willing to risk by selling this type of coverage. According to some insurers and brokers with whom we spoke, commercial space launch third party liability coverage is a specialized market involving a relatively small number of insurers that each assumes a portion of the risk for each launch. One broker said that no launch company thus far had pursued private sector insurance protection above \$500 million. Two insurers said that there might be slightly more coverage available beyond \$500 million, and one said that up to \$1 billion per launch in liability coverage might be possible in the private insurance market. For this statement, we contacted one of those insurers, who indicated that current capacity is still approximately \$500 million.

The cost to launch companies for purchasing third party liability insurance, according to some brokers and one insurer, was approximately 1 percent or less of the total coverage amount. According to FAA data on commercial launches, the average maximum probable loss is about \$82 million. As a result, in the absence of CSLA indemnification, insurers could still provide some of the coverage currently available through the government under CSLA. For example, if the maximum probable loss for a launch is \$100 million and the insurance industry is willing to offer up to \$500 million in coverage, the private market could potentially provide \$400 million in additional coverage.

According to some insurers, brokers, and insurance experts with whom we spoke, there were a number of reasons why private sector insurers

were generally unwilling to offer more third party liability coverage than \$500 million per launch.

- First, these brokers and insurers said that worldwide capacity for third party liability coverage was generally limited to \$500 million per launch, which some considered a significant amount of coverage and a challenging amount to put together—particularly given that the number of insurers in the space launch market was relatively small.
- Second, according to these same officials, insurers were unwilling to expose their capital above certain amounts for coverage that at least currently brings in small amounts of premium relative to the potential payouts for losses. For example, they said that losses from a catastrophic launch accident could exceed many years of third party liability policy premiums and jeopardize insurers' solvency.
- Third, according to some insurers and brokers with whom we spoke, to have sufficient capital to pay for losses above \$500 million per launch would require insurers to charge policy premiums that would likely be unaffordable for space launch companies.

Changes to Market Capacity

The current amount of private market capacity could change due to loss events and changing market conditions, according to some insurance industry participants. Some insurers and brokers said that a launch failure could affect the level and cost of coverage offered, and that a launch failure with significant losses could quickly raise insurance prices and reduce capacity, potentially below levels required by FAA's maximum probable loss calculation. However, one risk expert suggested that a space launch failure would likely cause liability insurance rates to rise and that this might encourage insurers and capital to enter the space launch market and cause liability insurance capacity to increase. According to FAA, insurers have paid no claims for U.S. commercial launches to date, but they have paid some relatively small third party claims for U.S. military and NASA launch failures. For example, according to an insurance broker, a U.S. Air Force launch failure in 2006 resulted in property damage of approximately \$30 million. According to NASA, the Space Shuttle Columbia accident in 2003 resulted in property damage of approximately \$1.2 million. Two brokers said that given the low number of launches and low probability of catastrophic events, total worldwide premiums for space liability coverage are approximately \$25 million annually, amounts insurers believe are adequate to cover expected losses. However, if a large loss occurs, according to two insurers, they

would likely increase their estimates of the potential losses associated with all launches.

Under CSLA, launch companies must purchase coverage to meet FAA's maximum probable loss amount or purchase the maximum amount of coverage available in the world market at reasonable cost, as determined by FAA.²⁰ The potential cost to the government could increase if losses caused insurance prices to rise and insurance amounts available at reasonable cost to decrease. Some insurers and brokers also said that the amount of insurance the private market is willing to sell for third party liability coverage for space launches can also be affected by changes in other insurance markets. For example, large losses in aviation insurance or in reinsurance markets could decrease the amount of capital insurers would be willing to commit to launch events because losses in the other markets would decrease the total pools of capital available.

Alternatives for Addressing Space Launch Risk

While we had not conducted specific work to analyze the feasibility of alternative approaches for providing coverage currently available through CSLA, FAA and others had looked at possible alternatives to CSLA indemnification and we have examined different methods for addressing the risk of catastrophic losses associated with natural disasters and acts of terrorism.²¹ These events, like space launch failures, have a low probability of occurrence but potentially high losses. Some methods involve the private sector, including going beyond the traditional insurance industry, in providing coverage, and include the use of catastrophe bonds or tax incentives to insurers to develop catastrophe surplus funds. Other methods aid those at risk in setting aside funds to cover their own and possibly others' losses, such as through self-

²⁰51 U.S.C. § 50914(a)(3).

²¹See FAA, *Liability and Risk-Sharing Regime for U.S. Commercial Space Transportation: Study and Analysis*, and Aerospace Corporation, *Study of the Liability Risk-Sharing Regime in the United States for Commercial Space Transportation*. See also GAO, *Catastrophe Insurance Risks: The Role of Risk-Linked Securities and Factors Affecting Their Use*, GAO-02-941 (Washington, D.C.: Sept. 24, 2002); *Catastrophe Insurance Risks: The Role of Risk-Linked Securities*, GAO-03-195T (Washington, D.C.: Oct. 8, 2002); and GAO, *Natural Disasters: Public Policy Options for Changing the Federal Role in Natural Catastrophe Insurance*, GAO-08-7 (Washington, D.C.: Nov. 26, 2007).

insurance or risk pools.²² Still other methods, such as those used for flood and terrorism insurance, involve the government in either providing subsidized coverage or acting as a backstop to private insurers.²³

Use of any such alternatives could be complex and would require a systematic consideration of their feasibility and appropriateness for third party liability insurance for space launches. For example, according to a broker and a risk expert, a lack of loss experience complicates possible ways of addressing commercial space launch third party liability risk, and according to another risk expert, any alternative approaches for managing this risk would need to consider key factors, including the

- number of commercial space launch companies and insurers and annual launches among which to spread risk and other associated costs;
- lack of launch and loss experience and its impact on predicting and measuring risk, particularly for catastrophic losses; and
- potential cost to private insurers, launch companies and their customers, and the federal government.

As such, alternatives could potentially require a significant amount of time to implement.

²²See GAO, *Catastrophe Insurance Risks: Status of Efforts to Securitize Natural Catastrophe and Terrorism Risk*, GAO-03-1033 (Washington, D.C.: Sept. 24, 2003). Self-insurance occurs when an entity assumes the risk for its losses and can involve the formation of an insurance company solely for that purpose. Risk pooling occurs when two or more entities agree to set aside funds to help pay for the others' losses.

²³See GAO, *Flood Insurance: FEMA's Rate-Setting Process Warrants Attention*, GAO-09-12 (Washington, D.C.: Oct. 31, 2008) and *Terrorism Insurance: Status of Efforts by Policyholders to Obtain Coverage*, GAO-08-1057 (Washington, D.C.: Sept. 15, 2008).

**Forecasted Increase
in Manned Launches
and Reentries Could
Increase the Potential
Costs for the Federal
Government, and
Current Coverage
Has a Gap**

**Issues and Implications
Relating to Commercial
Manned Launches and
Reentries**

Planned increases in manned commercial launches raises a number of issues that have implications for the federal government's indemnification policy for third party liability, according to insurance officials and experts with whom we spoke. NASA expects to begin procuring manned commercial launches to transport astronauts to the ISS in 2017. In addition, private companies are also developing space launch vehicles that could carry passengers for space tourism flights.

First, the number of launches and reentries covered by federal indemnification will increase with NASA's planned manned launches which will be FAA-licensed commercial launches.²⁴ NASA expected to procure from private launch companies 2 manned launches per year to the ISS from 2017 to 2020. In addition, the development of a space tourism industry may also increase the number of launches and reentries covered by federal indemnification, but the timing of tourism launches and reentries is uncertain.

According to insurance company officials with whom we spoke, the potential volume of manned launches and reentries for NASA and for space tourism could increase the overall amount of insurance coverage

²⁴NASA-contracted launches for NASA's science missions are not currently covered by CSLA; rather, NASA requires its launch contractors to obtain insurance coverage for third party losses. The amount of the insurance required by NASA is the maximum amount available in the commercial marketplace at reasonable cost, but does not exceed \$500 million for each launch. The facts and circumstances for claims in excess of this amount would be forwarded by NASA to the Congress for its consideration 51 U.S.C. § 20113 (m) (2). NASA-contracted launches for the Commercial Resupply Services to the ISS will be licensed by the FAA under CSLA, and will be covered by CSLA indemnification.

needed by launch companies, which could raise insurance costs, including those for third party liability.²⁵ By increasing the volume of launches and reentries, the probability of a catastrophe occurring is also increased and any accident that occurs could also increase future insurance costs, according to insurance company officials with whom we spoke. A catastrophic accident could also result in third party losses over the maximum probable loss, which would invoke federal indemnification.

Second, because newly developed manned launch vehicles have less launch history they are viewed by the insurance industry as more risky than "legacy" launch vehicles. Insurance company officials told us that launch vehicles such as United Launch Alliance's Atlas V, which launches satellites and may be used for future manned missions, is seen as less risky than newer launch vehicles, such as SpaceX's Falcon 9, which could also be used for manned missions. According to insurance company officials with whom we spoke, they expect to charge higher insurance premiums for newly developed launch vehicles than legacy launch vehicles given their different risk profiles. Insurance company officials' opinions varied as to when a launch vehicle is deemed reliable—from 5 to 10 successful launches. They also told us that whether vehicles are manned is secondary to the launch vehicle's history and the launch's trajectory—over water or land—in determining risk and the price and amount of third party liability coverage.

Third, having any people on board a space vehicle raises issues of informed consent and cross waivers, which could affect third party liability and the potential cost to the federal government. CSLA requires passengers and crew on spaceflights to be informed by the launch company of the risks involved and to sign a reciprocal waiver of claims (also called a cross waiver) with the federal government—which means that the party agrees not to seek claims against the federal government if an accident occurs. CSLA also requires cross waivers among all involved parties in a launch. Two key issues dealing with cross waivers include the estates of spaceflight passengers and crew and limits on liability for involved parties.

²⁵Launch providers obtain insurance in addition to that for third party liability, including coverage of assets, such as the launch vehicle.

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- The estates of spaceflight passengers and crew, which are considered third parties to a launch, are not covered by the informed consent and cross waiver of claims, according to two insurance companies and one legal expert. Although an insurance company said that it would be difficult for estates to seek damages in case of an accident, the legal expert said that the informed consent requirement does not address future litigation issues. Officials from two insurance companies and one expert told us that they expect spaceflight passengers to be high-income individuals, which could result in large insurance claims by estates of the passengers, as determination of the amount of claims is based on an individual's expected earning capacity over his or her lifetime.
 - According to two insurance companies and two legal experts, requiring cross waivers among passengers, crew, the launch company, and other involved parties may not minimize potential third party claims as they would not place limitations on liability. An insurance company and a legal expert stated that, without a limitation on liability, insurance premiums for third party and other launch insurance coverage could increase as the same small number of insurance companies insures passengers, crew, launch vehicles, as well as third parties to a launch. According to FAA, putting a limitation on spaceflight passenger liability could foster the development of the commercial space launch industry through lower costs for insurance and liability exposure. Liability exposure and the related litigation impose costs on industries and the limitation on liability shifts the risk to spaceflight passengers, who have been informed of the launch risks. If limitations on liability were set by federal legislation, it could conflict with state law because at least five states had their own space liability and indemnity laws limiting liability.²⁶ Launch and insurance companies believe that a limit or cap on passenger liability could decrease uncertainty and consequently decrease the price of insurance, according to a FAA task force report.²⁷

As previously discussed, the potential cost to the government depends on the accuracy of the maximum probable loss calculation, which assesses a launch's risk. If the calculation is understated, then the government's

²⁶Those states are Colorado, Florida, New Mexico, Texas, and Virginia.

²⁷FAA, *FAA's Response to NASA on the Insurance Task for Commercial Crew* (Washington, D.C.: Apr. 30, 2012).

exposure to liability is higher. Thus, whether the launch vehicle is newly developed or manned, the effect on the government's potential cost for third party claims is still based on how accurately the maximum probable loss calculation assesses launch risks. FAA officials told us that they intend to use the same maximum probable loss assessment method for manned launches as they currently do with unmanned launches.

Gap in Federal Indemnification

Officials from the insurance industry and space launch companies and an expert told us that a gap in federal indemnification was the lack of coverage of on-orbit activities—that is, activities not related to launch or reentry, such as docking with the ISS and relocating a satellite from one orbit to another orbit—but they did not agree on the need to close this gap. FAA licenses commercial launches and reentries, but does not license on-orbit activities. Federal indemnification only applies to FAA-licensed space activities. NASA's commercial manned launches to the ISS that will involve on-orbit activities, including docking with the ISS, will be subject to the cross waivers of liability required by agreements with participating countries. This cross waiver is not applicable when CSLA is applicable, such as during a licensed launch or reentry, and it does not address liability for damage to non-ISS parties such as other orbiting spacecraft. Claims between NASA and the launch company are not affected by the ISS cross waiver and are historically addressed as a contractual agreement. In addition, one commercial space launch company's operations will only have suborbital launches and reentries and no on-orbit activities that require regulation. Officials from two launch companies stated that they did not believe that on-orbit activities need to be regulated by FAA or that federal indemnification coverage should be provided. However, one insurer noted that other proposed manned launches—such as one company's planned on-orbit "hotel"—will not be NASA related and therefore will not be covered by any regulatory regime. An expert noted that such a proposal for an on-orbit hotel remains an open question regarding regulation and liability exposure. In addition, the expert noted that federal oversight of on-orbit activities may be needed to provide consistency and coordination among agencies that have on-orbit jurisdiction. He pointed out that the Federal Communications Commission and the National Oceanic and Atmospheric Administration have jurisdiction over their satellites and NASA has jurisdiction over the ISS. Thus, according to the expert, there should be one federal agency that coordinates regulatory authority over on-orbit activities.

At the time of our July 2012 report, FAA senior agency officials said that they might seek statutory authority over on-orbit activities but as of

January 2014 have not done so. An insurer told us that having FAA in charge from launch to landing would help ensure that there were no gaps in coverage. According to this insurer, this would help bring stability to the insurance market in the event of an accident as involved parties would be clear on which party is liable for which activities. However, having FAA license on-orbit activities would increase the potential costs to the federal government for third party claims. If FAA obtains authority to license on-orbit activities then the potential costs to the government may increase as its exposure to risk increases.

**Ending
Indemnification Could
Potentially Decrease
U.S. Competitiveness**

Based on work for our July 2012 report, the actual effects that eliminating CSLA indemnification would have on the competitiveness of U.S. commercial launch companies are unknown. For example, we do not know how insurance premiums or other costs might change as well as the availability of coverage. In addition, we do not know whether or to what extent launch customers might choose foreign launch companies over U.S. companies. Furthermore, it is difficult to separate out the effects of withdrawing indemnification on the overall competitiveness of the U.S. commercial space launch industry. Many factors affect the industry's competitiveness, including other U.S. government support, such as research and development funds, government launch contracts, and use of its launch facilities, in addition to the third party indemnification.

While the actual effects on competition of eliminating CSLA indemnification are unknown, several launch companies and customers with whom we spoke said that in the absence of CSLA indemnification, increased risk and higher costs would directly affect launch companies and indirectly affect their customers and suppliers. The same participants said that two key factors—launch price and launch vehicle reliability—generally determine the competitiveness of launch companies. According to two launch customers, launch prices for similar missions could vary dramatically across countries. For example, at the time of our July 2012 report two customers said that a similar launch might cost about \$40 million to \$60 million with a Chinese launch company, about \$80 million to \$100 million with a French launch company, and approximately \$120 million with a U.S. launch company. However, another U.S. launch company told us that it was developing a vehicle for a similar launch for which it intended to charge about \$50 million. Other considerations also would be involved in selecting a launch company, according to launch customers with whom we spoke. For example, some said that export restrictions for U.S. customers could add to their costs or prevent them from using certain launch companies. One launch customer also said that

it considered the costs of transporting the satellite to the launch site as well as other specific aspects of a given launch.

Launch company officials said that the lack of government indemnification would decrease their global competitiveness by increasing launch costs. Launch company officials said their costs would increase as a result of their likely purchase of greater levels of insurance to protect against the increased potential for third party losses, as the launch companies themselves would be responsible for all potential third party claims, not just those up to the maximum probable loss amount. As previously discussed, whether the private insurance market has the capacity to provide coverage at levels currently provided by the government, or at what price they might sell such coverage, is uncertain. Some launch company officials said that their costs may also increase if their suppliers decided to charge more for their products or services as a result of being at greater risk from a lack of CSLA indemnification. That is, to compensate for their greater exposure to potential third party claims, some suppliers might determine that they need to charge more for their products to cover the increased risks they are now assuming. Some launch companies told us that they would likely pass additional costs on to their customers by increasing launch prices. Two launch customers told us that in turn, they would pass on additional costs to their customers. Several also told us that they might increase the amount of their own third party liability insurance, another cost they might pass on to their customers. Two said they might be more likely to choose a foreign provider if the price of U.S. launches rose.

According to launch companies and customers we spoke with, ending CSLA indemnification would also decrease the competitiveness of U.S. launch companies because launch customers would be exposed to more risk than if they used launch companies in countries with government indemnification. For example, officials from several launch companies and customers said that if some aspect of the launch payload is determined to have contributed to a launch failure, they could be exposed to claims for damages from third parties. Launch customers are currently protected from such claims through the CSLA indemnification program. Several launch customers with whom we spoke said that without CSLA indemnification they might be more likely to use a launch company in a country where the government provides third party indemnification.

According to launch companies with whom we spoke, ending CSLA indemnification could also have other negative effects. For example, some said that the increased potential for significant financial loss for third

party claims could cause launch companies, customers, or suppliers to reassess whether the benefits of staying in the launch business outweigh the risks. If some companies decided it was no longer worthwhile to be involved in the launch business, it could result in lost jobs and industrial capacity. Lastly, one industry participant pointed out that some suppliers, such as those that build propulsion systems, have to maintain significant amounts of manufacturing capacity whether they build one product or many. If there are fewer launches, the cost of maintaining that capacity will be spread among these fewer launches, resulting in a higher price for each launch. To the extent that the federal government is a customer that relies on private launch companies for its space launch needs, it too could face potentially higher launch costs.

Concluding Observations

Although the number of commercial launches by U.S. companies has been lower in the past few years than in years prior, commercial space is a dynamic industry with newly developing space vehicles and missions. With the termination of the shuttle program, NASA has begun to procure cargo delivery to the ISS from private launch companies and intends to use private companies to carry astronauts to the ISS starting in 2017. In addition, private launch companies have been developing launch vehicles that will eventually carry passengers as part of an emerging space tourism industry. Both of these developments would increase the number and type of flights eligible for third party liability indemnification under CSLA. As the industry changes and grows, continually assessing federal liability indemnification policy to ensure that it protects both launch companies and the federal government will be important. This assessment would be impacted by the amount of coverage the insurance industry is willing to provide for space launches, which depends on a number of factors including the number of launches and reentries and insurers' ability to evaluate the underlying risks. To the extent insurance capacity might increase, it could reduce the need for indemnification under CSLA. It is also possible, however, that certain events, such as a launch failure with large losses, could reduce insurance industry capacity for this type of coverage. Review of potential alternative means for addressing the risks associated with space launches, while beyond the scope of our work, would also be an important part of any ongoing assessment of CSLA indemnification.

Several factors raise questions about FAA's methodology for determining the maximum probable loss for a commercial space launch, which determines the amount of insurance coverage launch companies must buy and the amount above which government indemnification begins.

During work for our July 2012 report, FAA said it believed its approach was conservative, but acknowledged that parts of the maximum probable loss methodology have not been updated, including a dollar amount for estimating space launch losses from casualties and fatalities which the insurance industry says is outdated. In addition, FAA used this estimate of losses from casualties and fatalities as the basis for estimating potential property damage, an approach that could underestimate property losses. Moreover, FAA had not had outside experts and risk modelers review its methodology. FAA officials told us that subsequent to our prior report they have taken some initial steps toward revising and updating their MPL methodology, but that budget constraints have prevented further progress in the short term. FAA officials have recently suggested that the Consolidated Appropriations Act of 2014 provides the resources to assess the MPL methodology, possibly as soon as March 2014. We agree with FAA that the benefits of developing and implementing a potentially more comprehensive maximum probable loss methodology need to be balanced against the possible increased costs to the agency and to launch companies. However, the importance of a sound calculation makes review of the current methodology a worthwhile effort. An inaccurate maximum probable loss value can increase the cost to launch companies by requiring them to purchase more coverage than is necessary, or result in greater exposure to potential cost for the federal government. Thus, we continue to believe that our July 2012 recommendation that FAA periodically review and update as appropriate its methodology for calculating launch providers' insurance requirements has merit and should be fully implemented.

Chairman Palazzo, Ranking Member Edwards, and Members of the Subcommittee, this concludes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

GAO Contacts and Staff Acknowledgements

If you or your staff have any questions about this testimony, please contact Alicia Puente Cackley at (202) 512-8678 or cackleya@gao.gov, or Gerald L. Dillingham, Ph.D. at (202) 512-2834 or dillinghamg@gao.gov

Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement.

GAO staff who made key contributions to this testimony are In addition to the contacts named above, Teresa Spisak and Patrick Ward (Assistant

Directors), Chris Forys, David Hooper, Maureen Luna-Long, Sara Ann Moessbauer, and Steve Ruszczyk made key contributions to this report.

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Alicia Puente Cackley is a Director in the Financial Markets and Community Investment team at the U.S. Government Accountability Office. She oversees policy research and program evaluation on a broad range of insurance, consumer protection, housing and finance issues. Ms. Cackley received her Ph.D. in economics from the University of Michigan, and has been with GAO since 1990.

GAO Highlights

Highlights of GAO-14-328T, a testimony before the Committee on Science, Space, and Technology.

Why GAO Did This Study

A catastrophic commercial launch accident could result in injuries or property damage to the uninvolved public, or "third parties." In anticipation of such an event, a launch company must purchase a fixed amount of insurance for each launch, per calculation by FAA; the federal government is potentially liable for claims above that amount up to an additional \$1.5 billion, adjusted for inflation, subject to congressional appropriations. As of 2013, the inflation-adjusted amount is about \$3 billion. CSLA provides for this payment, called indemnification.

This testimony is based on a July 2012 report and January 2014 updates to FAA launch data, FAA progress on implementing GAO recommendations, and insurance industry capacity. It discusses (1) the U.S. government's indemnification policy compared to policies of other countries; (2) the federal government's potential costs for indemnification; (3) the ability and willingness of the insurance market to provide additional coverage; and (4) the effects of ending indemnification on the competitiveness of U.S. launch companies.

What GAO Recommends

GAO continues to believe that its July 2012 recommendation that FAA periodically review and update as appropriate its methodology for calculating launch providers' insurance requirements has merit and should be fully implemented.

View GAO-14-328T. For more information, contact Alicia Puente Cackley at (202) 512-8678 or cackleya@gao.gov or Gerald L. Dillingham, Ph.D. at (202) 512-2834 or dillingham@gao.gov.

February 2014

COMMERCIAL SPACE LAUNCHES

FAA's Risk Assessment Process Is Not Yet Updated

What GAO Found

According to studies, the United States in 2012 provided less commercial space launch indemnification for third party losses than China, France, and Russia. These countries put no limit on the amount of government indemnification coverage which in the U.S. is limited by the Commercial Space Launch Act (CSLA). Governments' commitments to pay have never been tested because there has not been a third party claim that exceeded a private launch company's insurance.

The potential cost to the federal government of indemnifying third party losses is currently unclear. This is because it depends in part on the method used by the Federal Aviation Administration (FAA) to calculate the amount of insurance that launch companies must purchase, which may not be sound. FAA had used the same method since 1988 and has not updated crucial components, such as the cost of a casualty. Estimating probable losses from a rare catastrophic event is difficult, and insurance industry officials and risk modeling experts said that FAA's method was outdated. An inaccurate calculation that understates the amount of insurance a launch provider must obtain would increase the likelihood of costs to the federal government; a calculation that overstates the amount of insurance needed would raise the cost of insurance for the launch provider. FAA officials said that their method was reasonable and conservative, but agreed that a review could be beneficial and that involving outside experts might be helpful. FAA officials said that subsequent to GAO's 2012 report they have taken initial steps to improve their methodology for estimating probable losses.

The insurance market is generally willing and able to provide up to about \$500 million per launch as coverage for third party liability, according to industry representatives. Because the amount of insurance FAA requires launch providers to obtain averages about \$82 million per launch, and coverage available through CSLA is about \$3 billion above that, insurers could provide some of the coverage currently available through CSLA. However, the amount and price of insurance that could be provided could change quickly if a large loss were to occur, according to insurance industry representatives.

The effects on global competition from the United States eliminating CSLA indemnification are unknown. However, launch companies and customers GAO contacted believe that ending federal indemnification could lead to higher launch prices for U.S.-based launch companies, making them less price competitive than foreign launch companies. Although the cost of third party liability insurance for launch companies has been about 1 percent of the dollar amount of coverage they purchased, how much this cost might increase in the absence of federal coverage is not clear. Launch customers said that price and vehicle reliability were key factors in their choice of a launch company. Launch companies reported that additional costs would be passed along to customers, but whether this increase alone would be sufficient reason for a launch customer to choose a foreign company over a U.S. company is not clear.

Chairman PALAZZO. Thank you, Dr. Cackley.
I now recognize our final witness, Dr. Hertzfeld, for five minutes.

**TESTIMONY OF DR. HENRY HERTZFELD,
RESEARCH PROFESSOR OF SPACE POLICY
AND INTERNATIONAL AFFAIRS,
ELLIOT SCHOOL OF INTERNATIONAL AFFAIRS,
GEORGE WASHINGTON UNIVERSITY**

Dr. HERTZFELD. Thank you very much. Thank you for the opportunity to testify today on the topic of updating the Commercial Space Launch Act.

Chairman PALAZZO. Microphone, please.

Dr. HERTZFELD. I am sorry. I will start again.

Thank you for the opportunity to testify today on the topic of updating the Commercial Space Launch Act. This act has proven to be a very powerful and productive force in stimulating commercial space transportation in the United States. The Department of Transportation through the Federal Aviation Administration has carried out its obligations well and the United States is recognized as a responsible nation in administering commercial space launch activities. The FAA has also been successful in promoting commercial space endeavors. The fact that regulations have remained predictable, stable, consistent, and have been administered with fairness and transparency is alone enough to provide confidence in the domestic and international commercial communities.

But there are some considerations that the Congress should address as commercial space activities evolve. The first is jurisdictional. The DOT is an agency with expertise in administering rules concerning all types of transportation but it has no special expertise in the fields of resource extraction, energy generation, or Moon landings, all of which are being seriously proposed for outer space commercial projects. In fact, Congress has not granted to any agency specific regulatory powers over most activities in outer space. And examples of that include launching a payload from a platform in space; oversight of a commercial payload landing on an asteroid or other celestial body; extracting, moving, or returning Earth resources from space.

It is important to remember that by treaty agreements, the United States Government as a launching state is ultimately liable for damages from these activities should something go wrong. Rather than expand the scope of the CSLA, I would recommend that Congress consider allocating future jurisdiction over nontransportation issues to agencies with the required expertise in those areas. That has been the approach Congress has chosen in the past, witnessed by the Department of Commerce licensing of remote sensing payloads in the earlier FCC licensing of telecommunications satellites.

The—at the same time, Congress should clearly define the jurisdictional limits of the CSLA in order to avoid overlaps. The topic of indemnification, if there were a catastrophic accident in space involving a U.S. Government or corporate asset, politics and international relations rather than any Congressional limit would likely determine who would pay and how much. The good news of course is that the probability of such a catastrophic accident in space is

relatively small. The bad news is that some orbits are becoming crowded and there is a growing probability that an accident with large economic consequences could happen.

This coupled with emerging space capabilities such as satellite servicing, active debris removal, or moving asteroids will raise new insurance and indemnification issues. Examples again are, although launch insurance is required, satellite insurance is not. The United States could undertake an effort to negotiate international agreements for limits to liability for damages in space. There is no international enforceable and binding dispute resolution system for commercial accidents in outer space. Binding arbitration might be one to consider. The United States Government should adopt incentives for private industry to develop its own insurance pool to possibly eliminate the need for government indemnification.

Regarding the experimental period for suborbital human flight, there is no clear answer to when the experimental period should end, but it certainly will have to be extended beyond 2015. There are a number of companies developing human suborbital systems. Each company has a different technological approach making any end to an experimental period unique to each. Congress is faced with a dilemma. If it ends the experimental period when the first company is deemed to be successful, it penalizes late starters, but if it continues it indefinitely, then final regulations for safety in suborbital vehicles will be greatly delayed, possibly risking lives and damage.

In regard to other nations, all launching states are parties to the Outer Space Treaty, have agreed to assume liability and indemnify launches, but there is no guarantee that if a problem occurs in space, all will handle it the same way or in a way that will be satisfactory to other nations. With the exception of a major unilateral shift in the indemnification regime such as terminating the U.S. Government's guarantee, it is unlikely that the current CSLA or any changes to it will significantly alter the competitiveness of U.S. launch companies.

In summary, the CSLA has proven to be effective and responsive to U.S. industry's needs. However, because of the diverse spread of expertise and responsibility among different federal agencies, the Congress should address the interagency coordination of all United States space activities so that future commercial space licenses will be handled effectively, efficiently, and quickly with the maximum transparency that is possible.

Thank you very much.

[The prepared statement of Dr. Hertzfeld follows:]

TESTIMONY FOR HEARING ON
NECESSARY UPDATES TO THE COMMERCIAL SPACE LAUNCH ACT

UNITED STATES HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON SPACE

HENRY R. HERTZFELD
SPACE POLICY INSTITUTE
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THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, D.C.

FEBRUARY 4, 2014

Thank you for the opportunity to testify today on the topic of updating the Commercial Space Launch Act. I am pleased that the Committee has engaged on the important process of reviewing these matters. The space industry in the United States is undergoing some very significant changes as more commercial space activities move from planning and design phases to manufacturing, launch, and customer-based outer space projects. It is very timely to begin a review of existing U.S. law in light of national and international issues that will need to be resolved in the years ahead as these private activities in space grow and evolve.

I will discuss both near-term and long-term issues that will need Congressional review of the role of the Commercial Space Launch Act of 1984, as amended. This legislation authorizes the regulations that the DOT/FAA Office of Commercial Space Transportation implements.

Strengths of the current CSLA:

This Act has proven and continues to be a very powerful and productive force in stimulating commercial space transportation in the United States that is used for both government and private payloads. Its two basic regulatory functions are overseeing the safety of payloads and launches and insuring that the companies involved are financially responsible. Important other functions are the promotion of commercial space

transportation and in recent years the administering of regulations for future experimental suborbital commercial launches of people to the edge of outer space.

The legislation recognizes not only domestic economic and technological issues but it also recognizes our international obligations under the U.N. treaties that we have ratified on space affairs. The DOT/FAA has carried out its obligations well and the U.S. is recognized as a responsible nation in administering commercial space launch activities.

The FAA has also been successful in promoting commercial space endeavors. Even without any specific “cheerleading” for commercial space, the fact that the regulations have remained predictable, stable, consistent, and have been administered with fairness and transparency is alone enough to provide confidence in the domestic and international commercial communities.

Issues of current and future consideration for Congress

Jurisdiction Issues

But there are some considerations that the Congress should address as commercial space activities evolve. The first is to clearly define which federal agencies have jurisdiction over different types of specific activities. The DOT and the FAA under it is an agency with expertise in administering rules concerning transportation and specifically air and space transportation. Until recently commercial space, other than telecommunications and earth observations satellites, has been focused since the late 1980s on private launch vehicles and that is the primary focus of the CSLA and of the FAA’s Office of Commercial Space Transportation. Currently there are a number of U.S. companies that are well advanced in the development of various new launch vehicle projects, some suborbital and some aimed at orbital or even more distant space destinations.

In recent public reports there are at least two companies preparing plans for resource extraction on asteroids. There are a number of companies vying for the Google Lunar XPrize that entails safely landing a payload on the Moon. There are companies building

equipment for outer space as well as planning other projects as diverse as landing humans on Mars or generating power from space platforms.

It is obvious that all of these efforts will require space transportation and therefore they or their launch company will have to get a license from the FAA for launch (and reentry, if that is also planned). At present, Congress has not granted regulatory authority to any agency for most of these newly developed commercial activities that will take place in outer space, or on celestial bodies. Yet, issues of safety, international responsibility, and liability will remain with the Federal Government as mandated by our treaty agreements. The question for the Congress will be to determine what agencies within the Government will best provide the expertise and oversight of these non-transportation activities occurring in outer space.

The FAA has no special expertise in the fields of resource extraction, energy generation, or in many other activities planned for space. Their jurisdiction in space affairs should clearly be defined and preferably limited to those issues directly related to launching and reentry. Their more general Congressional mandate to promote commercial space has led the FAA to issue a legal response to an activity that involves space equipment but is only marginally related to launching or reentry. This decision concerned a recent license request for a balloon to be placed by a commercial company well within national airspace at 30 km altitude. The reasoning for this approval was two-fold, 1) the payload was for testing equipment that was designed to withstand conditions in outer space, and 2) their enabling legislation, the CSLA (Chapter 509 of U.S. Code Title 51), allowed for the FAA to issue this license. However, as the letter opinion clearly recognizes, a balloon is not a rocket launch.

This decision illustrates a policy decision more concerned with promoting commercial space than with the core mission of the FAA's Office of Commercial Space. They could easily have ruled that this test was limited to airspace and would fall under traditional FAA air regulations. There was nothing inherently or legally incorrect with their ruling. In fact, it may be helpful to the company developing equipment for space tourism. But, in the absence of other agencies with jurisdiction to oversee activities in outer space, the

willingness of the FAA Office of Commercial Space to rule on this and other matters, suggests that there may be future issues where they may go well beyond their existing Congressional mandate to regulate commercial launches.

The Congress should study and review the scope of the jurisdiction in regulating space activities that has been granted to the DOT/FAA under the CSLA. Questions such as the ones below will arise more frequently.

- If a payload is “launched” from a platform in space (rather than from Earth directly), should that activity be considered legally as a separate launch and subject to FAA jurisdiction or is it beyond any existing U.S. regulatory regimes?
- How long before the actual act of reentry should the FAA have jurisdiction while the vehicle/payload is still in outer space?
- Is a suborbital flight that goes into the legal regime of outer space the same as a suborbital flight that never leaves domestic airspace?
- What criteria will be developed to determine the end-of-life of a vehicle or payload and what are the appropriate regulatory provisions applicable to a decommissioned payload that remains in orbit?
- Does FAA transportation oversight apply in outer space when a commercial payload lands on a celestial body?
- If celestial resources are moved in space, are those actions under FAA regulatory authority and if so, at what point in the process would the FAA jurisdiction begin and end?

These, and other questions are not clearly answered in the CSLA. They will arise if many of the current commercial plans become operational. And, it is important to remember that by treaty agreements, the United States Government as a launching state is ultimately liable for damages from these activities should something go wrong.

I would recommend that Congress study this issue and allocate future jurisdiction over non-transportation issues to agencies with the required expertise in those areas. At the

same time, Congress should clearly define the jurisdiction limits of the CSLA in order to avoid overlapping jurisdictions.

Indemnification

In 1988 the Congress agreed to indemnify for damages from an accident involving a launch from the United States up to \$1.5 Billion (today, with the legislatively required inflation adjustments that figure is above \$2.5 Billion). The DOT/FAA requires private companies to either buy or show the ability to pay an amount equal to the maximum probable loss from a launch. That insurance requirement is capped at \$500 million (the estimate of the amount the insurance industry can underwrite for any given launch) and is determined by estimates for each type of launch vehicle. Since the Outer Space Treaty and the Liability Convention do not provide any limits to a nation's liability, either in amount or in time, the United States could be faced with a claim of any amount. If there ever were a catastrophic accident in space involving a U.S. government or corporate asset, politics and international relations rather than any Congressional limit will likely determine who would pay and how much.

The good news is that the probability of such a catastrophic accident in space is relatively small. To date, although there have been collisions of satellites in space; none have resulted in economic losses that were large enough to warrant a claim or legal suit. Although such an accident is always possible, the probability is very low. And, even if something happened that created compensable damages, the provisions of the treaties require the finding of fault and the likely sharing of the damages if there are multiple nations involved.

The bad news is that some orbits in space are becoming crowded with human-created debris. There is a growing probability that something catastrophic with large economic consequences could happen as we launch more satellites into space and as the world's economies become more dependent on satellite applications and services. This, coupled with emerging space capabilities such as satellite servicing, active debris removal, and moving/using asteroids and other NEOs, will raise new insurance/indemnification issues.

Another approach that the Congress might want to consider and study would be to separate the U.S. Government's 3rd party indemnification regime into two parts. The first adheres to Article II of the Liability Convention, which mandates absolute liability for space objects falling to Earth, and would provide for an unlimited 3rd party liability provision for damages from space objects to terrestrial property or assets (including aircraft in flight). The second would be a different indemnification regime that follows Article III of the Liability Convention and would include caps on liability for fault-based incidents occurring in outer space and where the damages are solely to assets or property in outer space.

Additionally, current international space law lacks an effective dispute resolution system. Diplomatic negotiations have worked well in the past when all space assets were government owned and operated. In today's emerging commercial space activities, there will be accidents involving private space assets and a likely need for a binding and enforceable dispute resolution system. One possibility, frequently used in other commercial domains, would be a requirement that if the parties cannot settle their differences through direct negotiations, the national launch license would include a provision that mandates binding arbitration under existing bilateral and multilateral treaties. To be effective, this type of dispute resolution system would have to be mandated not only in the United States but also in other space-faring nations. The United States Congress could take the lead in this effort by directing all of the licensing authorities in the United States include such a clause. However its value would depend on other nations also adopting similar requirements.

There are several other new situations that will need to be addressed, both to protect the United States Government as well as U.S. companies.

- Although launch insurance is required, satellite insurance is not.
- The United States could undertake an effort to negotiate international limits on damage in space from space assets? Such limits have been agreed to in other domains such as maritime losses.

- Since commercial launches may become frequent enough that, like the experience with civil nuclear insurance, can the U.S. Government develop incentives for the private industry to develop its own insurance pool and eventually be able to cover large damage claims without government indemnification?

Experimental Period of Time for Human Suborbital Flights

There is no clear time or answer to when to let the experimental period lapse and to develop clear rules for these companies.

The human space flight amendments of 2004 were originally to expire in 2012 based on the expectations that private suborbital flights would be routine by 2012. This eight-year period allowed the FAA to issue permits during this development period. Space flight is complex and difficult and the private sector has not as yet begun flights with paying passengers. In light of this, Congress extended the experimental period an extra three years to 2015. Clearly, even if there are test flights this year, that experimental period will continue well beyond 2015.

A further complication is that there are a number of companies developing human suborbital systems. Each company has a different technological approach, making any end to an experimental period unique to each company. Therefore, companies could conceivably argue for a continuation of this experimental period for an indefinite period in the future.

That would leave Congress with a dilemma—if it ends the experimental period when the first company is deemed to be successful, then it penalizes late starters using different technologies. But, if it continues indefinitely, then final regulations for safety and suborbital vehicles will be greatly delayed, possibly risking lives and damage.

As I have testified previously, Congress could consider a transfer of regulatory authority of suborbital flights that do not enter outer space to other FAA offices that regulate aircraft.

However, normal FAA rules would need special waivers so as not to place unrealistic financial and regulatory burdens on this relatively new activity. For example, commercial airplanes are regulated as common carriers. At least in the near-term, directly applying those regulations to suborbital spacecraft would be unduly burdensome to space flight participants and companies and would likely terminate that activity. Clearly, this is not the intent of this recommendation. The reason for the transfer would be to relieve the FAA's Office of Commercial Space from regulating activities within domestic air space in order that they could focus on their primary mission.

Comparisons with Regulations in Other Nations

Every nation approaches the issues of the oversight of space activities in different ways that reflect their own culture, history, society, and economy. More significant than the details of any specific legislative approach are the many, many other issues of economic competition. Normally, price is the market signal that consumers respond to. However, in the space sector almost every activity has dual-uses: government and private. Governments rarely use price alone as a determinant of a purchase decision. And, in space launches, even private customers have many other considerations for launch purchases. Regulations are one factor, but most likely not the major determinant of a competitive advantage or disadvantage at least for the vast majority of nations that have responsible and sophisticated space programs.

Because of the close relationship between defense, security, and government research in space, all nations take individual approaches to regulating space and to laws enforcing space treaty provisions. All nations indemnify launches, and all have ratified at least the Outer Space Treaty and agreed to assume liability. But, there is no guarantee that if a problem occurs in space, all will handle it the same way or in a way that will be satisfactory to all other nations.

Many nations that have companies that compete with the United States in the launch business are more business oriented and more "customer friendly." They tend to attract

business with incentives that are difficult to match in the United States. How well the newer U.S. launch companies such as Space X will compete when they demonstrate reliability equal to or better than Roscosmos or Arianespace is still in the future since all marketing plans (theirs and their competitors), prices, government relationships, and actual costs are unknown today. What is clear is that the elasticity of demand for space launches, particularly of the vehicles capable of launching heavy lift payloads, is very inelastic. That is, the demand is not very sensitive to price or regulatory differences, but is more determined by a customer's needs, timeliness, and reliability.

With the exception of a major unilateral shift in the indemnification regime (such as terminating the U.S. Government's guarantee), It is unlikely that the current CSLA or any changes to it will significantly alter the competitiveness of U.S. launch companies.

Finally, as I have testified previously, Congress might want to revisit the informed consent rules in the CSLA for space participants. I have two suggestions: First, that the FAA draft clauses dealing with information to be given to the space flight participant on accident risk history and other data that the FAA is in a better position to provide than private companies. These clauses should be required to be included in the consent form. However, the companies are still responsible for drafting the form and making it specific to their vehicles. 2) Second, states are starting to compete with each other by enacting laws that require passengers to sign waivers of liability that protect the private owner/operator of the suborbital vehicle. Currently Florida, Virginia, Texas, New Mexico, and California have these laws, each with different wording and slightly different legal implications. Federal preemption on this issue might be warranted to prevent competition among states on an issue that involves interstate commerce, and may adversely affect safety decisions the companies make concerning the vehicle and operations.

Conclusion:

In summary, the CLSA has proven to be effective and responsive to U.S. industry's needs. Since the launch and private space sector has evolved from being just an industry with

expendable launch vehicles to an industry of many facets, the CSLA will need to be adjusted to reflect these emerging changes.

Congress will either have to expand the jurisdiction of the CSLA beyond launching activities or it will have to develop new regulatory agencies for the types of activities that go beyond transportation issues. In the past the latter has been the approach the Congress has chosen, witnessed by the DOC/NOAA licensing remote sensing payloads and the earlier FCC licensing of telecommunications satellites.

I would recommend that Congress study this issue and allocate future jurisdiction over non-transportation issues to agencies or specially created committees, as needed, with the required expertise in those areas to work with either the DOT/FAA or another designated agency to coordinate the process of licensing. At the same time, Congress should clearly define the jurisdiction limits of the DOT/FAA in order to avoid overlaps in jurisdiction.

Furthermore, where necessary, the Congress should address the overall interagency coordination of all United States space activities so that future licenses will be handled effectively, efficiently, and quickly, with the maximum transparency possible.

**HENRY R. HERTZFELD**

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Chairman PALAZZO. Thank you, Dr. Hertzfeld.

I thank the witnesses for being available for questioning today. Reminding Members that Committee rules limit questioning to five minutes, the Chair will at this point open the round of questions. The Chair recognizes himself for five minutes.

When Congress enacted the law to promote commercial human spaceflight in 2004, it included an eight-year learning period to allow industry to innovate without excessive regulation while allowing the FAA to write rules based on actual problems during licensed flights. Unfortunately, it has taken a long time for the industry to emerge so Congress extended this for the full duration of the FAA Reauthorization Act in 2012, basically until September 30, 2015. It is my understanding that FAA's Commercial Space Transportation Advisory Committee, COMSTAC, has recommended that the learning period be restored to a full eight years from the first licensed flight of a spaceflight participant. Do you agree with the FAA advisory committee's recommendation? I would like to start with Dr. Nield.

Dr. NIELD. Mr. Chairman, if I could, I would like to tell you a little bit about what the FAA has been doing since Congress extended the learning period to give some context to the question itself.

When we were asked to engage with industry about this subject, we went out and consulted with industry, specifically with COMSTAC, with NASA, with the Civil Aerospace Medical Institute (CAMI) as part of the FAA, and with academia, specifically the Center of Excellence for Commercial Space Transportation, and asked for their help and advice. We then held a series of eight public teleconferences to discuss what the FAA's oversight should look like, what levels of safety are appropriate, abort systems, fault tolerance, design margins, medical best practices, communications, and many other topics.

And after reviewing the data and the lessons learned from the last 50 years of human spaceflight, we developed a draft document entitled "The Established Practices of Human Spaceflight Occupant Safety." We posted that on our website and asked for comments from industry and from NASA. We are currently in the process of reviewing those comments and we hope to finalize the document this year. The ultimate goal is to gain the consensus of government, industry, and academia. And really, the document has two purposes, first of all, to serve as a framework and a benchmark for industry to use in developing industry consensus standards, and secondly, to serve as a baseline and a starting point should there be a need for government to issue regulations at some point in the future once the moratorium has expired. So, that sets the stage for where we are. I would be happy to expand on that later if you have time.

Chairman PALAZZO. Well, thank you, Dr. Nield.

Dr. Hertzfeld, would you like to add anything to that?

Dr. HERTZFELD. No, I don't think I can. I think that an arbitrary extension at this point such as the eight years that you had mentioned in your question might not be wise, but I think there is at some point a judgment call that will have to be made to end that period, and it should be based I think on the technical basis of the

experience that we have had, particularly from the early flights and the expectations from any of the companies that might be in the wings to begin to start.

Chairman PALAZZO. The FAA interprets the CSLA to require a company with a licensed vehicle design to forfeit its ability to continue testing and improving that design once it has been put into service. Can you explain why the FAA believes it does not have the flexibility to allow these vehicles to continue testing, Dr. Nield?

Dr. NIELD. Yes. Our interpretation of the current law is that an experimental permit can only be used for specified purposes, basically for training or for demonstrating compliance, whereas a license can be used for compensation and hire, basically for commercial use. And although it has been mentioned already today that the intent was not to prevent or make difficult the opportunity to go back and forth, the way we read the current law, once a license is issued for a vehicle of the same design that currently has a permit, the permit would no longer be valid. Now, there is a way forward, which is you can still continue to do testing under a launch license, but under current law, we can't go back and forth.

Chairman PALAZZO. In 2012, GAO recommended that FAA should review the MPL calculation to ensure it is sound. How far along is FAA in the process and what have you found so far, again, Dr. Nield?

Dr. NIELD. We completely agree with the GAO recommendations. We believe we have a reasonable process which has been conservative, but we solicited and welcomed outside scrutiny and recommendations on how to improve the process. We have come up in house with what we think is a more objective and more accurate way of calculating the maximum probable loss. What we would like to do is spend the next 12 months basically to do an IV&V—independent verification and validation—of that software to make sure that it can be used for these very important decisions, basically how much insurance each company has to go get, and, again, we think it would be also valuable to have outside experts critique that, although there may be some funding requirements that are associated with that. So we would be happy to come back to the Committee later on in the year and give you a better progress report, but that is where we are right now.

Chairman PALAZZO. Thank you.

I now recognize Ms. Bonamici for five minutes.

Ms. BONAMICI. Thank you very much, Mr. Chairman, and thank you to the witnesses for bringing your expertise to the Subcommittee.

Dr. Hertzfeld, I want to ask about accident investigation involving commercial space operations. What will we need to know if we needed to determine what entity, whether it be an existing or new entity, should have the authority to investigate commercial spaceflight accidents, including those involving human spaceflight participants? How should investigations be handled? What type of expertise would be needed? And are there other high-risk industries that can serve as models?

Dr. HERTZFELD. I really have not given that any thought in preparation for the testimony today, but when I testified in 2011, I believe I did address a couple of issues related to that. And I think

the National Transportation Safety Board generally has authority to investigate accidents related to transportation. Unless the law has been changed, space was left out of the actual list of those modes to which they would investigate. But I believe there is an MOU between the Commercial Space Office and the National Transportation Safety Board for accidents above a certain limit amount or those involving human beings would be under their jurisdiction. And if we go back to the Shuttle Columbia accident, I believe they were also involved because they had a lot of expertise in this area. NASA of course in the human spaceflight has had experience as well in accident investigation, but when something like this happens, the expertise within the government is found among the various agencies and I don't think any agency would decline to participate.

Ms. BONAMICI. Thank you. And I am going to ask Dr. Nield, what data should industry be required to collect in order to facilitate a potential accident investigation should an accident occur?

Dr. NIELD. We currently require a lot of information as part of a launch license process in terms of the vehicle and toxic propellants and the trajectories, what the hazards are, and so forth, so we already have that in place. And as Dr. Hertzfeld mentioned, we currently have MOUs, Memorandums of Understanding, between the FAA, the National Transportation Safety Board, and the Department of the Air Force to conduct investigations should there be an accident that occurs in the future.

Ms. BONAMICI. Can you think of any data that isn't being collected that might facilitate an accident investigation or it is your position that everything that should be collected is already being collected?

Dr. NIELD. I think we have a good set of requirements in terms of what information we need upfront. To build on your question though I think what could really help the industry going forward is a greater willingness to share information about close calls and incidents and accidents that do occur among the various companies. And of course that could be a difficult issue when you talk about proprietary data—

Ms. BONAMICI. Right.

Dr. NIELD. —and competition, but that could really help the safety.

Ms. BONAMICI. Terrific. Thank you.

And for all the members of the panel, the Commercial Space Launch Act requires that space operators, before receiving compensation or agreeing to fly a spaceflight participant, inform each participant in writing about the risks of the launch and reentry, and it is my understanding that that is according to the vehicle type.

Now, some say that informed consent is not a waiver of liability for any enhanced exposure to injury caused by the operator's carelessness, if any, and they advocate having each spaceflight participant exchange a liability waiver with the commercial launch provider. So basically, parties would agree not to file claims against the other party if there is an accident. Now, there are concerns about the rights of the passengers and their families and that they should be protected in the event of an accident. So what are your

views on whether there should be cross waivers between spaceflight participants and commercial launch providers? Is informed consent still appropriate as we move to regularly scheduled and paid suborbital flights?

And I think I will start with Dr. Hertzfeld. I don't know if the other of you are lawyers. It is a bit of a legal question.

Dr. HERTZFELD. The way the system works today is the wording of the informed consent statement is left to the companies, I believe. Many states that have spaceports or are considering spaceports have passed legislation with wording on the informed consent, and each one is slightly different. And I think that is something of concern.

Looking ahead, it is quite fine for states to compete against each other for economic reasons, but some of these laws are aimed at protecting the operator from a suit by one of the passengers if something went wrong and with the exception I believe of willful actions or gross negligence. They read differently and this may be something that the federal government should consider for preemption and it might be—because the FAA has more data, more information on all of the companies and all of the risks, wording that perhaps should be drafted by the FAA and be uniform throughout the country.

Ms. BONAMICI. Thank you very much.

And I see my time is expired. I yield back. Thank you, Mr. Chairman.

Chairman PALAZZO. I now recognize Mr. Rohrabacher for five minutes.

Mr. ROHRABACHER. Thank you very much. And I am going to have to be out of here in five minutes so I will get right to it. Dr. Nield, now, you are going to have to correct me if I am wrong in my assessment on what the law says, but right now, when some company like I guess Virgin Galactic gets a space launch license, at that point their ability to continue testing is highly restricted, is that correct?

Dr. NIELD. Just to be precise, currently Scaled Composites has the permit for SpaceShipTwo.

Mr. ROHRABACHER. All right.

Dr. NIELD. Virgin will be the eventual customer and they have applied for a launch license.

Mr. ROHRABACHER. Right.

Dr. NIELD. But once that license is issued, the use of a permit is invalidated.

Mr. ROHRABACHER. So they can't go—so what we are saying is that it makes sense to restrict the testing of something that has already been approved—well, we can't—we don't believe in perfecting it anymore or make it even a little more safer. Does that make any sense to you, that we are actually stopping a company that might want to test to see if there is more perfections they can do of their technology?

Dr. NIELD. That doesn't make any sense at all, and I would certainly not recommend that. Now—

Mr. ROHRABACHER. Okay. So—

Dr. NIELD. —additional testing could take place under a license, but—

Mr. ROHRABACHER. Yeah.

Dr. NIELD. —if there is bureaucracy involved here, then we ought to take a look at improving that.

Mr. ROHRABACHER. Mr. Chairman, I guess that means that what we—something we can do in the law to make sure that because someone has received a license, that they are not cut off then from improving what they have, the technology that they have, but that is necessary right now for us to change the law for that to happen.

And let me ask, right now, you have got 18 federal agencies that in some way have something to do with the launch industry, and it was decided and we tried to focus most of this regulation on the Department of Transportation and the FAA Commercial Space Office. Doctor, you seem to be suggesting that we need to have more offices and more different bureaucrats involved complicating the process more rather than facilitating something that we need to develop in our country. You know what they say is bureaucracy is the most efficient system ever devised to turn creative energies into solid waste. And you seem to be advocating more government bureaucrats than less.

Dr. HERTZFELD. Not exactly. I used the word agencies in my testimony—

Mr. ROHRABACHER. Yeah.

Dr. HERTZFELD. —that is correct, but I am focusing more on expertise, wherever that might come from and however it might be best coordinated throughout the federal government. And even with 18 agencies involved, there is an intergovernmental review of all these licenses that goes to a number of agencies, and that process is apparently not working quite as well as it might and has slowed down some licenses so that whether the—there is also, as I mentioned, a void in the law about on-orbit and in outer space activities—

Mr. ROHRABACHER. Right.

Dr. HERTZFELD. —so that we are going to have to close that at some point, and when we do, many of these areas of other expertise will be necessary, and I think we have to—

Mr. ROHRABACHER. Well, I would hope that when we have areas of expertise that we don't set up a system in which someone who wants to participate in this incredible new avenue for human entrepreneurship, that we have them going to 20 different offices in order to talk to 20 different government officials in order to get—curry favor with each one of them, and if one of them doesn't put the stamp on the paper, well, you can't do what you want to do. And, believe me, there are a lot of businesses in our country that face this kind of overregulation and we should be very cautious not to put that type of burden on this new entrepreneurial effort in space.

Dr. HERTZFELD. I agree with you. On the other hand, safety is one of the things that we do have to be very much aware of and that we do have to get the right information and have people who understand what is going on, work with those who are regulating.

Mr. ROHRABACHER. Well, maybe we could put them in the same office so they don't have to walk across town or something or—

Dr. HERTZFELD. Could happen.

Mr. ROHRABACHER. Thank you very much. Thank you. And, Mr. Chairman, thank you.

Chairman PALAZZO. I now recognize Mr. Schweikert for five minutes.

Mr. SCHWEIKERT. Thank you, Mr. Chairman.

Educate me a little bit. How many countries right now are launch-capable or part of the international treaty, the compact?

Dr. NIELD. There are a number of countries who are involved in space in some way, but today, only China and Russia are able to launch people into space.

Mr. SCHWEIKERT. But how many are part of some of the treaty mechanisms out there?

Dr. NIELD. Over 100.

Mr. SCHWEIKERT. Okay. Out of those 100, how many of them have a liability mitigation mechanic? Do they all take it as a government indemnification? Are there others that have bifurcated it or created a reinsurance mechanic? How do other countries also deal with this?

Dr. CACKLEY. Most of the other countries that we looked at—and we looked most specifically at China, Russia, France. Those are some of the main countries, and they all have a government indemnification program.

Mr. SCHWEIKERT. Is there any one that you know of—sorry, Mr.—Doctor—anyone out there who has actually broken that model of sort of a national insurance?

Dr. CACKLEY. Not that I am aware of but that doesn't mean it doesn't exist, but it certainly isn't among the largest companies that have the most launches that we have tracked.

Mr. SCHWEIKERT. Okay. To my other doctors—and this is easy, doctor, doctor, doctor.

Dr. HERTZFELD. There are about—there are 180—28 countries that have signed to ratify the Outer Space Treaty. There are about 11 countries with launch capabilities. Most other countries other than the ones mentioned are launching their own government satellites, so we are not really talking about the commercial end of it. And they have obligated themselves through the treaties to indemnify.

I will point out though that the definition of a launching state extends to countries that purchase a launch as well—

Mr. SCHWEIKERT. Well, you beat me to my next question. Is there bifurcation? You know, I am a private concern out of Taiwan. I approach the French. They are going to have—be my lift vehicle to put up a satellite. Do I carry a proportionality of risk? How is that mitigated?

Dr. HERTZFELD. Potentially, but the French—

Mr. SCHWEIKERT. Or—well, you only used the French but—

Dr. HERTZFELD. No, and I am using it as an example. They would require insurance of some sort or indemnification for the launch and—

Mr. SCHWEIKERT. How is that being acquired? So you are telling me if I am buying lift capacity, that as that purchaser, part of my—as I am out there in the market buying?

Dr. HERTZFELD. It would be included in the price of the launch.

Mr. SCHWEIKERT. Okay. And—but ultimately, I am paying the French Government for that?

Dr. HERTZFELD. Yes.

Mr. SCHWEIKERT. Okay. Just as a philosophical sort of touch, Congressman Rohrabacher was actually coming close to something and then let's see if I sort of express from a personal view and you tell me where I am right or wrong. I look at the internet, one of the most amazing sort of economic curves we can get our heads around, how it has changed the world, changed our lives, changed everything we are discussing and how we do our businesses. It is also something that had a very, very soft touch of government regulation, government intrusion, government control, government definitions. Why does that model not work in this world?

Dr. NIELD. In general, I think it does work and you need to look at the particular application. So when you are talking computers, then privacy and information scams and so forth are a concern, and the government has a role there—

Mr. SCHWEIKERT. But you also see what a great job the government does in managing that and stopping it. I mean at some point we have to deal with the reality of incentives and smart people committing bad acts.

Dr. NIELD. Good point, and I am all for industry designing, developing, operating space vehicles. I think the government does have an important role to ensure public safety, and to the extent appropriate, to encourage, facilitate, and enable the industry to be successful.

Mr. SCHWEIKERT. But if I was going to maximize public safety, does that safety really come from a command-and-control regulatory environment or does it come by actually sort of indemnification and insurance environment where the insurance world is actually able to think outside the box, think of other types of mitigation? My best example is that we regulate against securities fraud. You know, we have the entire SEC. We have all sorts of robustness out there, but somehow, bad things keep happening, but we do go in and bayonet the wounded after it is all over. So my fear is command-and-control regulatory environment often is at the back end of the disaster instead of the front end.

So, Mr. Chairman, with that, I am over my time. I yield back. Thank you.

Chairman PALAZZO. I now recognize Mr. Bridenstine from Oklahoma for five minutes.

Mr. BRIDENSTINE. Thank you, Mr. Chairman.

Just a couple of questions, Dr. Nield. When you talk about permitting, under a permit, that is when you do your testing, right? And then when you get licensed, that is when you do your operational flights?

Dr. NIELD. Yes, although a permit is voluntary. You can go right to license if you would like.

Mr. BRIDENSTINE. Okay. But you mentioned that under a license you can still do testing?

Dr. NIELD. Absolutely correct.

Mr. BRIDENSTINE. So how is that different than permitting?

Dr. NIELD. Congress established permitting somewhat similar to the way we have Experimental Airworthiness Certificates in avia-

tion before or instead of having a formal certification process for the aircraft itself. So under commercial space, if you want to do commercial ops, you need to have a license. If you just want to do some testing or training, you can operate under a permit and it is a little bit easier, a little bit—

Mr. BRIDENSTINE. So even if you have a license, you can still modify your aircraft for the betterment of the crew and the safety of the crew and everything else.

Dr. NIELD. Absolutely. And with your help, that would continue.

Mr. BRIDENSTINE. Okay. And then as far as the—we were talking about the learning period. The Chairman asked a question about extending it up to eight years after the first spaceflight participant flight. It—now, eight years—do you agree that we need to have the learning period extend beyond where we currently are in 2015 and extend it to eight years after the first spaceflight or I guess the first participant spaceflight?

Dr. NIELD. Thank you for that question, and I have to say, no, I do not agree with that and let me tell you why. The United States has over 50 years of experience in human spaceflight. Alan Shepard had his suborbital flight back in 1961. The X-15 was making rocket-powered suborbital flights back in 1962. The Space Shuttle, 135 flights over 30 years. Now, it is true that none of those carried a spaceflight participant who actually bought a ticket, but as far as I am concerned, the design and the operation of those vehicles really were independent of who was riding on board. Now, we had lots of lessons learned, data, problems solved, challenges overcome during that 50 years, and for us to just put that aside and say, well, let's start over without taking advantage of what we have learned I think is irresponsible.

Mr. BRIDENSTINE. Okay. So having that eight-year period originally would have been incorrect then, right?

Dr. NIELD. That would be my position, yes.

Mr. BRIDENSTINE. Okay. So we shouldn't have had the eight year—in your opinion, we shouldn't have had the eight years to begin with, let alone eight years going forward?

Dr. NIELD. That is correct. However, I am very sensitive to the concerns that industry has about government being overreaching and burdensome and holding things back. That is not what we want to do in the Office of Commercial Space Transportation. We want to enable safe and successful commercial operations.

Mr. BRIDENSTINE. Okay. Mr. Chairman, I yield back.

Chairman PALAZZO. Thank you. At this time we are going to go into a second round of questioning if there are no objections.

All right. I will yield myself five minutes.

And according to the experts in the insurance industry, there is a large pool of capital available for launch and payload insurance but this pool is also used for various other types of specialty insurance and is susceptible to quickly changing world events. Does GAO believe there is a sufficient amount of capital in the insurance market to allow for insurance at a reasonable cost within indemnification, Dr. Cackley?

Dr. CACKLEY. When we did our work in 2012, we spoke to a number of insurance companies and insurance brokers. We looked very carefully at the question of industry capacity to cover more than

the maximum probable loss that launch companies are currently required. And we very much discovered that there is more capacity than what is currently required, and the insurance companies told us that they had the capacity to go as high as \$500 million in coverage, but they did talk about the fact that that ability was very much dependent on future events. So as soon as there—if there were to be a large event—large impact event, that could change very quickly, and therefore, there isn't necessarily stability of provision of insurance going forward that the launch companies could necessarily count on. So we don't have a position as to whether there is and will always be greater capacity, but there certainly is a possibility for greater capacity of—than what insurance companies are currently providing.

Chairman PALAZZO. Okay. And my final question, and this is going to be for Dr. Nield, CSLA envisioned a single license to launch for commercial spaceflight companies, essentially a one-stop shop. It seems that FAA is having difficulty with how to regulate hybrid space vehicles which are part aircraft and part spacecraft. As I understand it, these vehicles are required to operate under different sets of regulations at different times of operation. This type of process is inefficient and expensive. Additionally, any time there are two sets of rules, gaps and conflicts can develop which can impact safety. How could the Office of Commercial Space Transportation and the Aviation Safety Office cooperate so that the aviation office provides all necessary input and expertise on airplane technology but the commercial space office has the one-stop shop role for the industry?

Dr. NIELD. Thank you for that question, and let me just say that the Office of Commercial Space Transportation and the Office of Aviation Safety do cooperate and do provide support to one another as appropriate. In terms of specific legislation, we certainly support a flexible regulatory structure which promotes growth, safely integrates operations into the National Airspace System, and leverages all the capabilities of the FAA. And we welcome the opportunity to provide additional technical assistance to the Committee as you consider avenues to correct the perceived obstacles to a streamlined operation.

Chairman PALAZZO. Thank you.

At this time I recognize Ms. Bonamici for five minutes.

Ms. BONAMICI. Thank you, Mr. Chairman, and thank you for allowing this second round of questions, especially since Members over here had to leave before they got to ask questions.

So for all of the distinguished panel, think back to the airline industry, the FAA previously had dual roles as both advocate and regulator of the airline industry, and that was eventually split and the FAA only retained the regulatory role. But in contrast now, the FAA has both roles regarding commercial space. So the Office of Space Commercialization in the Department of Commerce seems to complicate the issue as that office also has responsibilities that include industry advocacy. So what are the pros and cons of removing the advocacy role of the FAA, and if that decision is made, what entity or entities would be—or could be given that responsibility effectively? Dr. Nield, I will start with you.

Dr. NIELD. Thank you. I would point out that from the first passage of the Commercial Space Launch Act 30 years ago, there has been this dual role, on one hand, promote safety and on the other encourage, facilitate, and promote the industry. And that sounds to a lot of people like it could be a conflict and that question has come up over the years. Congress has asked for report. We have done independent studies. We have had debates about that. But as I look back, I think it has worked very well. To me, the "encourage, facilitate, and promote" role is a way of thinking. It is not a compromise of safety in any way. And if you look at the record, there have been 254 licensed or permitted launches in the last 30 years and none of them have ever had a fatality, serious injuries, or significant property damage. So I think we have the balance about right.

Ms. BONAMICI. Dr. Cackley or Dr. Hertzfeld, do you have the same opinion?

Dr. CACKLEY. Well, we haven't looked at the duplication across FAA and the Department of Commerce in particular, so I don't have an opinion specifically on them, but I do know that GAO has looked at duplication across the federal government and a lot of different areas and it is something we identify as a concern and something that should always be reviewed and considered as to whether there is something that could be done differently.

Ms. BONAMICI. Thank you. Dr. Hertzfeld?

Dr. HERTZFELD. Yes, certainly industry has not complained at this point, and I agree, it has worked fine up to now. I think there are a couple of issues that require monitoring in this area. When the agency was established in—the commercial space—launch regulation, we had one type of launch vehicle, ELVs. And then there was at a point which could come back at some day in the future reusable and relaunch and reentry vehicles that can come, land, and take off again. We don't have that now. But if we begin to have a series of different technologies, a series of different types of vehicles all regulated by one agency, then there could be an issue of some regulations favoring one type over another, all of them well-meaning but not coordinating in a way that—and it could affect companies in terms of promoting space.

Ms. BONAMICI. Thank you. And I am going to try to get one more quick question in, Dr. Hertzfeld. With the likelihood of more frequent commercial launches, I wanted to ask about your position on whether developing incentives for private industry to develop insurance pools rather than—as an alternative to government indemnification. So in your view, are there some examples of incentives that can have the potential for encouraging those insurance pools? Are they a possible alternative to indemnification, especially in light of the need for newer launch vehicles to pay higher premiums until they establish reliability?

Dr. HERTZFELD. I think the major test will be the growth of the industry. If there are enough launches, then there is possibly enough business to warrant that. In a slightly different way but the same scheme of indemnification was applied with the civil nuclear area and eventually they were able when we built enough nuclear power plants to have their own pool and cover their own insurance. I think it is a ways off but it is possible.

Ms. BONAMICI. Thank you very much, and I yield back. Thank you, Mr. Chairman.

Chairman PALAZZO. I now recognize Mr. Bridenstine for five minutes.

Mr. BRIDENSTINE. Thank you, Mr. Chairman.

Dr. Nield, your title, Associate Administrator for Commercial Space Transportation of the Federal Aviation Administration, and it was my understanding that—and correct me if I am wrong—that the FAA's Commercial Space Transportation Advisory Committee, COMSTAC, has recommended that the learning period be restored to a full eight years from the first licensed flight of a spaceflight participant. So what is your relationship with the advisory committee, and do you and the advisory committee differ in that opinion?

Dr. NIELD. The COMSTAC provides advice to the Administrator and to me about issues of interest to commercial space transportation, and we very much appreciate their advice. We are not looking for a rubberstamp or a validation of what we are trying to do. In this particular case, there is a difference that you pointed out between their recommendation and my recommendation to the Congress.

Mr. BRIDENSTINE. That is all I had, Mr. Chairman. Thank you.

Chairman PALAZZO. I want to thank the witnesses for their valuable testimony and the Members for their questions. The Members of the Committee may have additional questions for you, and we will ask you to respond to those in writing. The record will remain open for two weeks for additional comments and written questions from Members.

The witnesses are excused and this hearing is adjourned.

[Whereupon, at 3:25 p.m., the Subcommittee was adjourned.]

Appendix I

ANSWERS TO POST-HEARING QUESTIONS

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. George Nield

Responses of Dr. George C. Nield, Associate Administrator for Commercial Space Transportation, Federal Aviation Administration, to

Questions for the Record**Space Subcommittee Hearing****“Necessary Updates to the Commercial Space Launch Act”****February 4, 2014**

QUESTIONS FROM SUBCOMMITTEE CHAIRMAN STEVEN PALAZZO

1. How could Congress modify the regulatory regime to account for the development of different types of human launch systems which are at varying levels of technological readiness? For example, would the FAA regulate a balloon the same way it would a rocket or hybrid vehicle?

Response: Congress provided the direction in the Commercial Space Launch Act that “the regulatory standards governing human space flight must evolve as the industry matures so that regulations neither stifle technology development nor expose crew or space flight participants to avoidable risks as the public comes to expect greater safety for crew and space flight participants from the industry.” 51 U.S.C. § 50901(15). That said, the current statutory structure provides the FAA with flexibility to develop regulations that can accommodate a wide variety of technologies. As for the balloon, most of the FAA Office of Commercial Space Transportation (AST)’s regulations are performance based, leaving design solutions up to industry.

2. The current third-party liability risk-sharing regime has been in place for over two decades. The purpose of this regime was to assist a nascent industry that needed a backstop for possible third party claims in the event of an accident. Please explain to the Committee why the indemnification regime is still necessary.
 - a. What reforms do you think are necessary to the current regime?
 - b. If the purpose of the regime was to assist a new industry, when should Congress consider phasing it out?
 - c. Will regulations ever be necessary? If so, what market failure would they be designed to remedy?

Response: The President’s 2013 National Space Transportation Policy directs the Secretary of Transportation to “support continuation of the current liability risk-sharing regime for U.S. commercial space transportation activities, including provisions for the conditional payment of excess third-party claims by the United States Government...” The President’s Policy reaffirms the support for extension of indemnification voiced clearly since 2009 by the FAA’s Commercial Space Transportation Advisory Committee (COMSTAC). In fact, the Committee has stated that the extension is absolutely critical

to the commercial launch services industry. They have been clear that U.S. launch operators cannot expose themselves to unlimited liability.

We recognize that one of Congress' considerations in designing the regime's framework was to facilitate a stable market for private third-party liability insurance. Over the years, the Office of Commercial Space Transportation has paid close attention to the matter. Our focus has been on the domestic private industry's concerns as to market capacity, including impact on encouraging domestic commercial growth and third party protection in the case of an accident. In the past, both the domestic commercial space transportation industry and the insurance industry have informed us of the lack of stable private market capacity. GAO also noted statements by insurance industry representatives that the amount and price of insurance could change quickly if a large loss were to occur. Industry stakeholders have been clear that they need a stable risk-sharing framework, enabling both long term financial planning and reassurance of potential customers regarding predictability of contractual terms. Any consideration of phasing out the current regime should carefully consider these factors.

With regard to the third part of your question, the FAA's regulations regarding insurance and financial responsibility may be found at 14 C.F.R. part 440.

3. Should companies be allowed to fly passengers for compensation on hybrid systems if they are not launching to space? How can FAA allow flexibility to companies operating hybrid vehicles, but also not create a loophole in aviation regulations?

Response: The FAA has determined that experimental aircraft are not safe for commercial carriage under the Federal Aviation Act. Other restrictions also apply to experimental aircraft depending on the category. Exemptions to these regulations could lead to unintended loopholes in regulations. Assuming hybrid launch systems are not certified aircraft and are therefore experimental, passengers could not be carried for compensation or hire and other restrictions could apply.

If the Commercial Space Launch Act was expanded to allow operations under the Act directly required for space operations or preparation for space operations, then, conceivably, passengers could be carried in hybrid vehicles for preparation for space operations under the regulatory oversight of AST. The Administration has not developed a position on legislation.

4. Although it is extremely rare, there is a possibility of a space launch vehicle going off course and doing damage to third party property on the ground. Under current law, all of the entities that are involved in a launch are required to sign waivers of claim against each other, and then the entity with the launch license is required to obtain insurance against any such third-party claims that protects them, the government and all of the other entities. This regime is designed to ensure that anyone harmed in the launch is appropriately compensated but to avoid a ballooning set of lawsuits between the parties to determine who has to pay. There is currently one entity missing from this regime – the spaceflight participant. Your advisory committee has recommended including them. Do you believe that including the spaceflight participant in the regime would be an

improvement to minimize unnecessary lawsuits while maintaining an appropriate level of responsibility from all parties?

Response: 51 U.S.C. § 50914(b)(2) does require space flight participants to enter into reciprocal waivers of claims with the U.S. Government. The Administration does not have a position on expanding the beneficiaries of the reciprocal waivers of claims.

5. CSLA envisioned a single license to launch for commercial spaceflight companies—essentially a one-stop shop. It seems that FAA is having difficulty with how to regulate hybrid space vehicles, which are part aircraft and part spacecraft. As I understand it, these vehicles are required to operate under different sets of regulations at different times of operation. This type of process is inefficient and expensive. Additionally, anytime there are two sets of rules, gaps and conflicts can develop, which can impact safety. How could the office of Commercial Space Transportation and the Aviation Safety office cooperate so that the Aviation office provides all necessary input and expertise on airplane technology, but the Commercial Space Office has the one-stop-shop role for the industry?

Response: Hybrid launch system launches and reentries are conducted under a single launch license or experimental permit issued by AST. When the components of a hybrid vehicle are operated as aircraft, and not conducting a launch or reentry, they are regulated as aircraft. Within the Agency in all of these cases, AST is the entry point and primary interface with the applicant. We leverage the expertise of engineers and aviation inspectors from the Office of Aviation Safety and include them in technical level discussions, but our commitment is to make the internal processes between AVS and AST transparent to the applicant.

6. At the time that the CSLA was passed, every launch was regulated by 18 federal agencies. The Department of Transportation was given the lead on these efforts to make the process more efficient; however other agencies have recently become more involved in space launch and the space industry once again. How can the federal government push back on this bureaucratic creep and ensure that as few agencies as possible are involved in regulating the space industry?

Response: Innovation and creativity of the commercial space industry are pushing space technology in new and complex ways that may not be easily captured by statute or regulation. Consistent with our current mandate, we believe the appropriate response is to regulate only as necessary to address an existing problem and to consolidate regulations to avoid redundant and overly burdensome regulations. Under current law, AST has attempted to achieve regulatory flexibility. Simultaneously, AST has worked to address issues that enable the safe and continued growth of the space industry in areas of spaceport and human spaceflight development, launch and reentry, and debris mitigation. A balanced regulatory approach for commercial space transportation is needed to ensure legislation and regulation remain current enough to address safety needs, encouraging space industry growth without becoming either outdated or overly restrictive.

7. The FCC recently proposed new regulations for commercial payloads to orbit and amending the spectrum allocation tables for commercial launch companies to use spectrum to communicate with their spacecraft. This comes on the heels of a fairly public dispute between FAA and FCC on who has the authority to regulate orbital debris.
 - a. What is the FAA's opinion on the proposed FCC regulations?
 - b. Have the FAA and FCC worked out their disagreement about who has authority over orbital debris? What was the resolution of this dispute?

Response: AST provided comments to FCC in support of its proposed regulations on spectrum use for commercial space launch companies. Regarding authority over orbital debris, the 2013 National Space Transportation Policy recognizes the FAA's exclusive authority over orbital transportation activities comprising the end of launch.

8. The FAA regulates spaceports throughout the country and does not have a statutory limit on how many licenses it can offer.
 - a. What process does FAA have in place to ensure the industry does not become oversaturated with spaceports?
 - b. Do you believe that spaceport license applicants should pay for the cost the FAA incurs for processing their licenses?

Response: The FAA is required by statute to issue a launch site operator license to an applicant if doing so would be consistent with public health and safety, safety of property, and national security and foreign policy interests of the United States.

With respect to user fees, the Administration has not developed any proposal to modify the current bar in 51 U.S.C. § 50920 against collecting user fees.

9. The FAA interprets the CSLA to require a company with a licensed vehicle design to forfeit its ability to continue testing and improving that design once it has been put into service. Can you explain why the FAA believes it does not have the flexibility to allow these vehicles to continue testing?
 - a. What is the Office of Commercial Space Transportation's immediate plan for providing flexibility to operators, some of whom plan to conduct commercial flights this year?
 - b. It would make sense to afford companies every opportunity to make further safety and performance improvements to their vehicle designs, and then test those improvements using an experimental permit regime. Do you see value in allowing companies to continue to test their designs on newly-produced vehicles even after earlier vehicles have been entered into commercial service?
 - c. Would it make sense to allow companies to operate a vehicle under a license for hire and still make modifications under an experimental permit if the company then applied for an additional license for the newly modified vehicle?

Response: The FAA does not interpret the CSLA to require a company with a licensed vehicle design to forfeit its ability to continue testing and improving that design. We do, however, interpret the CSLA to require a company to test under a license rather than a permit after an operator receives a license. This is because 51 U.S.C. § 50906(g) states

that “[a] permit may not be issued for, and a permit that has already been issued shall cease to be valid for, a particular design for a reusable suborbital rocket after a license has been issued for the launch or reentry of a rocket of that design.”

We do see value in allowing companies to continue to test their designs on newly-produced vehicles even after earlier vehicles have been licensed for commercial operation. In certain circumstances, it may be helpful for companies to operate a vehicle under a license for hire and continue to make and test modifications to the vehicle design under permit, especially when there are two companies involved.

Virgin Galactic asked the FAA to suspend review of its license application so that Scaled Composites could continue its own operations under permit. The FAA agreed.

10. Your testimony goes to great lengths to make a case for granting your agency the authority to manage and regulate on-orbit operations. Why is the FAA best suited to handle this problem? One of the most important aspects to managing on-orbit traffic and orbital debris is tracking. What space surveillance assets or capabilities does the FAA possess to track or monitor orbital debris?

Response: If it were decided that Congress should extend governmental authority over transportation on-orbit, the FAA would be a logical choice. The FAA has experience and expertise. To effectively manage safety during all phases of flight, an agency needs space expertise and an accurate understanding of and information about the activities to be conducted and the status of other on-orbit objects. The FAA maintains a robust space expertise, and, through licensing applications, is already assessing the safety of planned activities for launch and reentry.

With regard to the second question, the FAA does not maintain space surveillance assets or capabilities. DoD operates a network that provides space surveillance information to interagency users which includes the FAA. The FAA does not foresee a need for duplicating existing facilities.

11. What impact does the cancellation of the FAA’s Joint Planning and Development Office have on the efforts to integrate commercial space launches into the National Airspace?

Response:

AST has its own dedicated resources and was never dependent on JPDO for inter-agency coordination and planning.

The FAA Administrator has established as a strategic goal the integration of commercial space activities into the National Airspace System (NAS). AST is collaborating with the Air Traffic Organization to safely integrate commercial space operations into the NAS. Additionally, FAA has established a \$1M research which includes the study of approaches to integrate commercial space activities into the NAS.

AST is also working closely with the Defense Department to coordinate integration of commercial space activities and has liaison offices at Patrick and Vandenberg Air Force Bases to coordinate activities with the Eastern and Western Ranges. An Air Force officer is assigned to AST as a full time liaison. Similarly, AST has NASA liaison offices with the Johnson and Kennedy Space Centers and at Wallops Island. NASA has assigned a full time liaison to AST.

QUESTIONS FROM RANKING MEMBER DONNA EDWARDS

1. What are your views on whether Congress should consider a one-size-fits-all policy and regulatory framework for commercial space transportation or whether Congress should consider different regimes for commercial human space transportation and for commercial unmanned space transportation, including for indemnification and commercial human spaceflight safety regulations?

Response: The Administration has not developed a proposal to modify the current statutory framework. However, as the industry evolves and matures, we are committed to working with Congress and looking for ways to encourage safe U.S. commercial space transportation activities. That said, the current statutory structure provides the FAA with flexibility to develop regulations that can accommodate both manned and unmanned space transportation for public safety.

2. How difficult is it to determine what defines a safe vehicle and an unsafe vehicle for commercial human spaceflight? If Congress had not prohibited FAA/AST's regulation of human safety on commercial human spaceflight systems until 2015, would your organization be ready to manage a process that leads to clear human safety regulations? What steps is FAA/AST planning to take beyond issuing the "Draft Established Practices for Human Space Flight Occupant Safety with Rationale"?
 - Are you aware of any industry efforts to contribute to such preparation through discussions on industry standards, for example?
 - How should FAA frame its safety regulations such that they are flexible in accommodating different designs and allow for updates but still give confidence that safety is achieved?

Response: With current technology, human space flight will involve considerable risk, so it would not be appropriate to say that any particular vehicle is safe or unsafe. What we might determine is whether or not the lessons learned from 50 years of human space flight have been applied by the designer, manufacturer, and operator of a vehicle, so as to not expose crew or space flight participants to avoidable risks.

Even if the current prohibition on proposing regulations governing the design or operation of a human space flight vehicle had never existed, we might not have proposed them, for two reasons. First, the rulemaking process is a multi-year effort, especially given our desire to work with industry to determine what lessons learned from 50 years of human space flight should apply to the commercial sector. Second, we have no evidence at this point that additional government regulations are necessary.

The FAA's "Draft Established Practices for Human Space Flight Occupant Safety" is part of the dialogue we are having with industry. We plan to issue version 1 of the document later this year. We are aware that the industry is talking about developing standards, and we hope the Established Practices document can help guide what safety topics are covered in standards.

If we were to ever issue regulations governing the design or operation of a human space flight vehicle, we would choose regulations that are performance based, to the greatest possible extent. Such an approach allows for flexibility in accommodating different designs, while also allowing for performance and safety updates.

3. In your prepared statement, you say that “the National Space Transportation Policy recognizes the importance of the FAA’s responsibility to execute exclusive authority in this area” [on-orbit operations]. Could you elaborate on your interpretation of the policy for FAA?

Response: Although the National Space Transportation Policy recognizes the FAA’s exclusive authority “to address orbital debris mitigation practices for U.S.-licensed commercial launches, to include launch vehicle components such as upper stages, through its licensing procedures,” the FAA does not possess authority over activities that are not part of launch or reentry. It is time to consider closing the current regulatory gap between launch and reentry.

4. The current cap on third party loss to government facilities, such as launch pads, is set in legislation at \$100 million. An examination of legislative history indicates that the \$100 million reflected (1) what was thought to be a reasonable figure for the value of government facilities and (2) what the insurance industry was willing to underwrite. With the value of government facilities having increased since then and the significant cost of impact from delays to other missions using the same launch pad and government facilities, if they are damaged, should that \$100 million cap be adjusted upwards?

Response: We are evaluating the appropriateness of the \$100 million cap in light of relevant considerations, including insurance availability and liability expectations.

5. Did FAA request funding required to solicit an outside review of how FAA calculates MPL levels – a key part of the GAO’s July 2012 recommendation as part of the fiscal year 2014 or fiscal year 2015 request? If not, why not?

Response: The GAO recommended that to better ensure the accuracy of FAA’s determination of the amount of insurance coverage required for an FAA launch license, the FAA should review and periodically reassess its MPL methodology, including assessing the reasonableness of the assumptions used. For these reviews, the FAA should consider using external experts such as risk modelers, document the outcomes, and adjust the methodology, as appropriate, considering the costs.

As a response to the GAO recommendations, our plan was to: 1) continue an internal effort to develop an improved MPL methodology, called the risk profile method, and 2) solicit input from our Commercial Space Transportation Advisory Committee (COMSTAC) regarding how best to conduct an external review of our methodology for calculating MPL.

With respect to the risk profile method, we conducted a two-day “technical interchange meeting” in July 2013 with our contractor ACTA, in order to plan a year-long effort to

complete the initial development of the risk profile method. We were not able to start the effort due to budget constraints. Fortunately, the Consolidated Appropriations Act of 2014 provides sufficient resources to AST to allow us to fund the effort, which we intend to do this year.

With respect to consideration of using external experts, we held a teleconference with the COMSTAC Business/Legal Working Group on Friday, January 25, 2013. Input from this teleconference was helpful in identifying options and issues relevant to review of MPL methodology.

Both the FY 2014 and FY 2015 AST budget requests note the importance of MPL methodology and the GAO recommendation for MPL review. The budget narratives do not request funding specifically for an external MPL review because this task must be considered in light of other important tasks, in a budgetary environment that continues to require prioritization of initiatives. We are currently evaluating the most cost-effective means of leveraging existing contract dollars and advisory committee expertise, so as to ensure that MPL methodology provides a fair and accurate tool within AST's liability risk-sharing framework.

6. In FAA's draft of established practices for human spaceflight, a note is included to the effect that the document does not discuss how a designer or operator would verify that they meet each safety measure in the document. There is also no mention as to whether FAA will have an independent means to do its verification or whether FAA will rely on evidence from the designer or operator as the basis of its validation.
 - How will FAA approach verification?
 - In light of the challenges NASA has in working toward certification of human safety requirements with potential commercial crew providers, how will FAA ensure it has the necessary expertise and knowledge to carry out any analyses needed?

Response: We plan to update the established practices document in the future with a discussion about verification. If we issued regulations in the future, major considerations in any rulemaking would include how an applicant would be required to verify that it met requirements, and what aspect of that verification the FAA would include in a license application. We anticipate that the FAA would need to acquire increased expertise in many aspects of human space flight.

7. **Part A.** In your prepared statement, you discussed the importance of engaging with the international community to "shape international standards to improve safety" and that FAA/AST has created an international outreach program to "promote the adoption of U.S. commercial space transportation regulatory approach." What is the status of that program?

Response: Since Fall 2008, the FAA has hosted detailed discussions of U.S. law and FAA regulations with representatives from: Japan, France, United Kingdom, Spain, Curacao, and the European Aviation Safety Agency (EASA).

We have also had discussions with officials from Canada, Sweden, Germany, Italy, United Arab Emirates, South Korea, Singapore, South Africa, the European Space Agency, and the European Commission. In the past two years, the FAA has exchanged letters of intent with Spain and Curacao and signed a similar intent memorandum with Italy.

Because few countries have rules specifically governing commercial activity, there is great interest in learning more about how the FAA approaches commercial space transportation safety. A few countries are now poised to introduce new legislation, to be followed by new regulations designed to attract suborbital space transportation vehicles to their spaceports. The European Union is also considering regulatory options. We believe our outreach efforts have had a positive effect and will help increase international safety, while enabling interoperability for U.S. industry.

Part B. What specifically is FAA/AST communicating to the international community, especially regarding human safety regulations?

Response: We typically present details about the 2004 Commercial Space Launch Amendments Act, showing how the FAA focuses on public safety but currently does not protect space flight participants. We also discuss goals the FAA has to support the growth of the U.S. commercial space transportation industry. In addition, we note that, if vehicles are operated by U.S. citizens outside the United States, the FAA still has a responsibility to license them. A common theme in discussions involves questions about the differences between a certification regime, which is typical in aviation, and the FAA's licensing regime for launch and reentry. To facilitate international dialogue, the FAA has released written papers at conferences on such topics as informed consent, certification versus licensing, industry standards, opportunities for commercial launch in space exploration, and integrating commercial space transportation operations into the National Airspace System.

Part C. In the absence of existing industry standards on human spaceflight safety, how does FAA/AST plan to "shape international standards to improve safety"?

Response: To build on a draft released in 2013, the FAA expects to release an initial version of a set of "established practices for human spaceflight occupant safety" in 2014. This document will identify subject areas that we believe could benefit from industry consensus standards. We will use this set of practices as a tool to advance dialogue with U.S. stakeholders on acceptable standards for human spaceflight safety. In addition, we intend to leverage the set of practices to help focus efforts, which have already begun, on human spaceflight safety in the international standards development community. Specifically, the International Organization for Standardization (ISO) has begun standards development work in this area. The FAA has engaged ISO to ensure harmonization of these efforts with U.S. safety goals, plans and objectives, and established practices. We have also received interest from, and have provided more information to, the International Aerospace Quality Group about these established practices.

8. In November of last year, NASA proposed to the Committee that the CSLA be amended to add the classification of Government Astronaut. In conjunction with this proposal, NASA asked FAA to interpret the CSLA as to whether astronauts would restrict NASA astronauts from performing operational functions during launch and reentry licensed by FAA. FAA concluded that astronauts, as space flight participants, could engage in operational activities.
- Your prepared statement noted that you agree with NASA's proposal to add Government astronauts to the CSLA. Does CSLA need to be updated to reflect this addition despite FAA's favorable interpretation?
 - Are there aspects of NASA's proposal that are not covered by FAA's interpretation?

Response: **Part A.** Yes. Adoption of the Administration's proposal is necessary for purposes of transparency and to ease the administrative burden on industry and the government. Under current statutory definitions, NASA astronauts are space flight participants and subject to all the requirements governing space flight participants. If someone is not aware of the FAA interpretations, a reading of the statute alone may raise concerns and create unnecessary burdens.

Response: **Part B.** Yes. The FAA's interpretations did not cover all aspects of NASA's proposal because the FAA was able to find that the U.S. astronauts would not have to sign such waivers, but the astronauts of NASA's international partners would have to sign them with respect to their personal property, although not with respect to death or injury.

9. There appears to be confusion regarding a company's flexibility to carrying out testing and make improvements to a vehicle (even if a second design vehicle is not being used for revenue bearing flights) once a commercial license has been issued for that particular design vehicle. Please clarify what is permitted and not permitted by FAA/AST under the statute. In your view, is additional flexibility beyond what the statute allows required, and if so, is legislation required to provide such flexibility or could it be handled administratively?

Response: A company may carry out testing and make improvements to a vehicle under a license even if another vehicle of the same design is being used. The company may not, however, carry out such testing under an experimental permit. This is because 51 U.S.C. § 50906(g) states that "[a] permit may not be issued for, and a permit that has already been issued shall cease to be valid for, a particular design for a reusable suborbital rocket after a license has been issued for the launch or reentry of a rocket of that design." The company can, however, carry out such testing under a license. The statutory lack of flexibility arises when two companies wish to operate the same vehicle or design under both a permit and a license concurrently. A legislative change would be required to provide additional flexibility beyond what the statute allows. The Administration has not developed a position regarding legislative changes.

10. You noted in the hearing in response to a question from Rep. Bonamici, that "what could really help the industry going forward is a greater willingness to share information about

close calls and incidents and accidents that do occur among the various companies.” What steps will FAA take to collect such information? Are there steps that Congress should take to facilitate industry's willingness to share information about close calls, incidents, and accidents? Should this information be required, and if so, what entity should be the recipient of the information?

Response:

The FAA currently has inspectors attend licensed and permitted operations of commercial space flight, and it performs an internal post-flight review which records incidents, accidents, and any known close calls.

The FAA is in the process of developing criteria for a database to collect information on incidents, accidents and close calls in a “lessons learned” format. If resources permit, FAA would qualitatively engage in “data mining” this data base in the future, when it would be populated to a greater extent. At this time, a large portion of commercial space flight activities are developmental in nature, and the configuration and operation of vehicles frequently changes. Once the configuration of a given vehicle stabilizes and its operations become routine and frequent, “data mining” this database quantitatively for trends to predict safety concerns could be pursued.

We are developing this database with the assistance of COMSTAC members and other experts who continue to provide feedback to refine it. We are creating data fields to house this information and encouraging industry to populate it on a voluntary basis. Much of the data are proprietary, and so it is currently up to the individual companies to provide this information. At this time, the FAA can only encourage, but cannot mandate, that companies share this data. The Administration has not developed a position regarding legislative changes.

11. Do you support having the Federal Government and FAA/AST specifically, develop a common informed consent form for spaceflight participants to sign, as required, before flying on FAA-licensed commercial human spaceflight systems? What role would NASA play in the development of such a form? What, if any, other actions should Congress consider regarding the safety risks to spaceflight participants in any potential updates to the CSLA and associated amendments?

Response: The FAA’s regulations at 14 C.F.R. § 460.45 contain the requirements common to all informed consent forms. Each operator will have to provide its own history and hazards because the history and design of each vehicle may differ. NASA may provide information on the history of its vehicles for the portion of the requirements that requires the disclosure of the risks of vehicles of the same type. The consent form required by paragraph (f) must identify the vehicle to which the consent applies, state that

the space flight participant understands the risks and his or her presence on board the vehicle is voluntary, and be signed and dated by the space flight participant.

14 C.F.R. § 460.45 Operator informing space flight participant of risk.

(a) Before receiving compensation or making an agreement to fly a space flight participant, an operator must satisfy the requirements of this section. An operator must inform each space flight participant in writing about the risks of the launch and reentry, including the safety record of the launch or reentry vehicle type. An operator must present this information in a manner that can be readily understood by a space flight participant with no specialized education or training, and must disclose in writing—

- (1) For each mission, each known hazard and risk that could result in a serious injury, death, disability, or total or partial loss of physical and mental function;
- (2) That there are hazards that are not known; and
- (3) That participation in space flight

may result in death, serious injury, or total or partial loss of physical or mental function.

(b) An operator must inform each space flight participant that the United States Government has not certified the launch vehicle and any reentry vehicle as safe for carrying crew or space flight participants.

(c) An operator must inform each space flight participant of the safety record of all launch or reentry vehicles that have carried one or more persons on board, including both U.S. government and private sector vehicles. This information must include—

- (1) The total number of people who have been on a suborbital or orbital space flight and the total number of people who have died or been seriously injured on these flights; and
- (2) The total number of launches and reentries conducted with people on board and the number of catastrophic failures of those launches and reentries.

(d) An operator must describe the safety record of its vehicle to each space flight participant. The operator's safety record must cover launch and reentry accidents and human space flight incidents that occurred during and after vehicle verification performed in accordance with § 460.17, and include—

- (1) The number of vehicle flights;
- (2) The number of accidents and human space flight incidents as defined by section 401.5; and
- (3) Whether any corrective actions were taken to resolve these accidents and human space flight incidents.

(e) An operator must inform a space flight participant that he or she may request additional information regarding any accidents and human space flight incidents reported.

(f) Before flight, an operator must provide each space flight participant an opportunity to ask questions orally to acquire a better understanding of the hazards and risks of the mission, and each space flight participant must then provide consent in writing to participate in a launch or reentry. The consent must—

- (1) Identify the specific launch vehicle the consent covers;
- (2) State that the space flight participant understands the risk, and his or her presence on board the launch vehicle is voluntary; and
- (3) Be signed and dated by the space flight participant.

QUESTIONS FROM CONGRESSMAN BILL POSEY

1. The U.S. is set to attain more than a third of all commercially available launches by 2014, due almost entirely to the emergence of domestic commercial launch providers. What factors do you perceive as contributing to this return, and do you think they will continue in the long-term? Why is this positive for the U.S.?

Response: In the U.S. market, the success of new U.S. vehicles developed by SpaceX and Orbital Sciences can be attributed to several factors, including: 1) vision, innovation and perseverance of company employees and leadership, 2) NASA's successful Commercial Orbital Transportation Services (COTS) program, 3) the use of Space Act Agreements by NASA and leadership to carry out COTS, and 4) stable funding and strong support from the Congress for COTS and operational contracts for Commercial Resupply Services (CRS).

All of these factors enabled industry to leverage government funding and the companies' own funding to deliver two new vehicles and spacecraft that can meet the needs of both the commercial market and the U.S. Government missions. In addition, SpaceX has indicated that in-house manufacturing of the Falcon 9 and Dragon spacecraft provides it control over quality, schedule and cost – all key elements from component manufacturing through launch operations.

In the international launch services market, customers have embraced lower prices and new competitive opportunities offered by SpaceX's Falcon 9, building on investments made by SpaceX and NASA. We hope that Orbital Sciences is also successful, as it begins to enter the international commercial market.

This is a positive development for the U.S. because it increases the number of U.S. jobs, contributes to the U.S. economy, and brings more international business into the U.S. In addition to resupply of the International Space Station, success of SpaceX thus far in signing customers in the geosynchronous orbit (GEO) market is especially welcome, following the decline of U.S. market share to competitors in Europe and Russia throughout the 2000s. Historically, the GEO market yields more revenue and has a higher and more stable demand for satellite launch, compared to satellites and other payloads seeking launch services to low Earth orbit and other non-geosynchronous orbits.

The SpaceX manifest has grown rapidly, reaching nearly 50 launch contracts, of which over 60 percent are for commercial customers (e.g., commercial satellite companies and government customers outside the U.S.). The forecast looks bright, in the longer term, for this positive trend to continue.

However, competitive pressures remain robust. The commercial ELV market is constantly changing, and GEO launch competitors in Russia and Europe are planning upgrades and new versions of their vehicles, while other providers from Japan, China, and India also hope to compete in the commercial market.

2. When it comes to spaceflight, suborbital and orbital are different in many ways, most obviously in altitude reached and the total number of flights conducted per year. As these industries continue to develop somewhat independently, to what extent do you foresee the regulatory environment evolving in different directions?

Response: Although the safety issues associated with orbital and suborbital space flight are similar in many ways, each flight regime has its own unique qualities. This is particularly true for human space flight. The safety expectations of the public may differ as well. Any future regulations would have to take these differences into account, including whether there is any need to have regulations in the first place. However, it is too early to tell to what extent they might differ.

Responses by Dr. Alicia Cackley

Questions for the Record

Commercial Space Launch Indemnification

Responses from Dr. Alicia Puente Cackley

Questions submitted by Representative Steven Palazzo, Chairman, Subcommittee on Space

1. As the industry moves closer to commercial human space flight operations, what is the effect on the third-party liability insurance market? Do you expect the cost of this insurance to increase with the introduction of commercial human launches?

According to insurance company officials with whom we spoke, the potential volume of manned launches and reentries for National Aeronautics and Space Administration (NASA) and for space tourism could increase the overall amount of insurance coverage needed by launch companies, which could raise insurance costs, including those for third party liability. By increasing the volume of launches and reentries, the probability that a catastrophe may occur may also increase, and any accident that occurs could increase future insurance costs. In addition, a catastrophic accident could result in third party losses over the maximum probable loss (MPL), which would invoke federal indemnification.

The extent to which commercial manned launches occur on newly-developed launch vehicles can also impact the cost of insurance. Because newly developed launch vehicles have less launch history they may generally be viewed by the insurance industry as more risky than "legacy" launch vehicles, or those vehicles that have performed more launches, and may have higher insurance premiums.

2. What changes, if any, would you expect to the method of calculating the MPL once commercial human launches begin?

Commercial human space launches alone would not likely change the method of calculating the MPL. Each MPL considers the specific circumstances of the launch including the launch site, planned launch vehicle, payload, flight path or trajectory, and potential fatalities and casualties resulting from various types of launch failures along many points of the launch vehicles' trajectory. Whether vehicles are manned is secondary to the launch vehicle's history and the launch's trajectory—over water or land—in determining risk and the price and amount of third party liability coverage.

3. GAO noted that the indemnification regime used in China, France, and Russia is essentially unlimited over a certain amount of insurance purchased by the launch provider. What effect does this type of indemnification regime have on overall global competitiveness in comparison to the regime used in the United States?

Launch company officials said that the lack of government indemnification would decrease their global competitiveness by increasing launch costs. Launch company officials said their costs would increase as a result of their likely purchase of greater levels of insurance to protect against the increased potential for third party losses, as the launch companies themselves would be responsible for all potential third party claims, not just those up to the maximum probable loss amount. Some launch company officials said that their costs may also increase if their suppliers decided to charge more for their products or services as a result of being at greater risk because of a lack of Commercial Space Launch Act (CSLA) indemnification. That is, to compensate for their greater exposure to potential third party claims, some suppliers might determine that they need to charge more for their products to cover the increased risks they are now assuming. Some launch companies told us that they would likely pass additional costs on to their customers by increasing launch prices. Two launch customers told us that in turn, they would pass on additional costs to their customers. Several also told us that they might increase the amount of their own third party liability insurance, another cost they might pass on to their customers. Two said they might be more likely to choose a foreign provider if the price of U.S. launches rose. According to launch companies and customers we spoke with, ending CSLA indemnification would also decrease the competitiveness of U.S. launch companies because launch customers would be exposed to more risk than if they used launch companies in countries with government indemnification.

As of July 2012, according to published reports, the United States provided less total third party liability coverage than China, France, or Russia, the primary countries that have conducted commercial space launches in the last 5 years. These countries each had an indemnification regime that assumes a greater share of the risk compared to that of the United States because each country had a two-tiered system with no limit on the amount of government indemnification. By comparison, the United States caps government indemnification at \$1.5 billion adjusted for inflation beyond the first-tier insurance amount. However, U.S. government coverage, in some cases, begins at a lower level than that of the other countries because U.S. coverage begins above the maximum probable loss, which averaged about \$82 million for

active Federal Aviation Administration (FAA) launch and reentry licenses in 2012, and ranged from about \$3 million to \$267 million. The level at which government coverage begins for the other three countries ranged from \$79 million to \$300 million.

Questions submitted by Representative Donna Edwards, Ranking Member, Subcommittee on Space

4. What are your views on whether Congress should consider a one-size-fits-all policy and regulatory framework for commercial space transportation or whether Congress should consider different regimes for commercial human space transportation and for commercial unmanned space transportation, including for indemnifications and safety regulations?

While we did not review the possible pros and cons of different policy approaches for commercial space launch indemnification, our findings suggest that accurate MPLs for any given launch and launch vehicle are central to making sure commercial space launches are adequately insured. An inaccurate calculation that understates the amount of insurance a launch provider must obtain would increase the likelihood of costs to the federal government; a calculation that overstates the amount of insurance needed would raise the cost of insurance for the launch provider.

FAA's process for issuing a license for a commercial launch or landing requires launch companies to purchase third party liability insurance in amounts determined by FAA. As a result, adequate industry capacity—or the ability of the insurance industry to provide this insurance—is also an important issue. We reported in 2012 that the maximum amount of third party liability coverage the insurance industry was willing to sell was around \$500 million, and our testimony in 2014 noted that this is still the available capacity for the industry. Several industry sources noted, however, that a launch failure could change or reduce capacity available in the market.

5. Can you please describe approaches used by the insurance industry for assessing and modeling risk in providing insurance for third-party liability and how they compare to FAA's approach?

Our findings suggest that FAA and the private sector may differ in their approaches for modeling space launch risk. FAA's methodology for determining potential property damage from a commercial space launch starts with estimating the total cost of casualties and then adds a flat 50 percent to that cost as the estimate of property damage instead of specifically analyzing the

number and value of properties that could be affected in the event of a launch failure. One insurer and two risk modelers with whom we spoke said that FAA's approach is unusual and generally not used in the private sector to estimate potential losses from catastrophic events. In particular, officials from modeling companies noted that the more common approach would involve modeling the property losses first and then derive the casualty estimates and costs from the estimated property losses. Additionally, a 2007 FAA review conducted with outside consultants said that FAA's approach is not recommended because of observed instances where forecasted casualties were low yet forecasted property losses, using an updated methodology, were very large.

Our 2014 testimony reported that FAA's method for assessing space launch risk also did not incorporate catastrophe modeling, but we did not find consensus among industry participants on the use of such modeling. One modeler suggested that catastrophe modeling has matured over the last 25 years and has become standard practice in the insurance and reinsurance industries while another thought that it would be possible to develop credible space launch simulation models. Others disagreed on how feasible it would be to mathematically model the potential damages associated with space launches. One expert thought such modeling would not be credible because knowledge of the factors that can influence a space launch is not at the same level as the more developed research for modeling for other events like hurricanes.

6. What did GAO's work find relative to the level established for third-party liability on U.S. government property?

The work we conducted in 2012 and 2014 did not specifically focus on the third party liability with respect to federal government property. However, a sound MPL calculation is critical because an inaccurate maximum probable loss value can increase the cost to launch companies by requiring them to purchase more coverage than is necessary. An inaccurate MPL can also result in greater exposure and potential cost for the federal government.

7. In your prepared statement, you indicated that industry experts told GAO that a significant cost factor in catastrophe modeling is creating and maintaining a detailed database of exposed properties and added that one expert told you that in order for FAA to do such modeling, it would need to purchase a property exposure database and that would likely cost several hundred thousand dollars. Did GAO identify the potential cost

of creating and maintaining a database? In your view, would an expense of several hundred thousand dollars be justified to enable such a capability?

FAA officials and insurance industry participants have considered the possibility of creating and maintaining a property exposure database, but some raised questions about whether doing so would be worth the expense and effort required. FAA officials told us that they had considered the possibility of using a catastrophe model based on use of data, but expressed concern about whether this approach would be more accurate, given uncertainty associated with modeling assumptions, including those on the probability and size of potential damages. A significant cost factor in catastrophe modeling is creating and maintaining a detailed database of exposed properties, something that would be very expensive. In addition, as noted above, industry sources disagreed on how feasible it would be to mathematically model the potential damages associated with space launches.

8. In your prepared statement, you indicated that insurance company officials told you that whether vehicles are manned is secondary to the launch vehicle's history and launch trajectory—over water or land—in determining risk and the price and amount of third party liability coverage. Did they make a distinction between suborbital and orbital manned flights?

FAA licenses commercial launches and reentries, but does not license on-orbit activities. Federal indemnification only applies to FAA-licensed space activities. Our 2014 testimony noted that some industry officials felt that a gap in federal indemnification involved on-orbit space activities—that is activities not related to a launch or reentry such as docking with the International Space Station (ISS) and relocating a satellite from one orbit to another orbit. We also reported that FAA officials said that they might seek statutory authority over on-orbit activities, but as of January 2014 had not done so. An insurer told us that having FAA in charge from launch to landing would help ensure that there were no gaps in coverage. According to the insurer, this would help bring stability to the insurance market in the event of an accident as involved parties would be clear on which party would be liable. Having FAA license on-orbit activities, however, would increase potential costs to the federal government for third party claims.

9. What are your views on the feasibility of developing incentives for private industry to develop insurance pools as an alternative to government indemnification? Are there

examples of incentives that can have the potential for encouraging those insurance pools?

While we did not conduct specific work to analyze the feasibility of alternative approaches for providing coverage currently available through CSLA, FAA and others have looked at possible alternatives to CSLA indemnification and we have examined different methods for addressing the risk of catastrophic losses associated with events such as space launch failures, natural disasters, and acts of terrorism.

Some methods involve the private sector, including going beyond the traditional insurance industry, in providing coverage, and include the use of catastrophe bonds or tax incentives to insurers to develop catastrophe surplus funds. Other methods aid those at risk in setting aside funds to cover their own and possibly others' losses, such as through self-insurance or risk pools. Still other methods, such as those used for flood and terrorism insurance, involve the government in either providing subsidized coverage or acting as a backstop to private insurers.

Use of any such alternatives could be complex and would require a systematic consideration of their feasibility and appropriateness for third party liability insurance for space launches. According to industry sources, a lack of loss experience complicates possible ways of addressing commercial space launch third party liability risk and any alternative approaches for managing this risk would need to consider key factors, including: the number of commercial space launch companies and insurers and annual launches among which to spread risk and other associated costs; the lack of launch and loss experience and its impact on predicting and measuring risk, particularly for catastrophic losses; and the potential cost to private insurers, launch companies and their customers, and the federal government. As such, alternatives could potentially require a significant amount of time to implement.

Dr. Henry R. Hertzfeld
Answers to the Questions for the Record

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON SPACE
"Necessary Updates to the Commercial Space Launch Act"

Questions submitted by Rep. Steven Palazzo, Chairman, Subcommittee on Space

1. How could Congress modify the regulatory regime to account for the development of different types of human launch systems which are at varying levels of technological readiness? For example, would the FAA regulate a balloon the same way it would a rocket or hybrid vehicle?

Either a system is experimental and under development or it is ready for a certification of flight worthiness from the FAA. (I'm using aircraft terminology, but the same concept should apply to commercial space.) The issue of regulating the balloon that was approved by the FAA for testing did not concern the balloon, but it was applied principally to the space hardware module that was being tested in airspace, not outer space. The transportation means of getting there was the balloon, not a rocket launch. Therefore I believe it should have been under the jurisdiction of the aviation part of the FAA, not the Office of Commercial Space Transportation. When the time comes for the company to actually test the module in outer space, the OCST should then supervise and regulate the experiment as a space payload, and one assumes it would be launched on a rocket.

2. When Congress enacted the law to promote commercial human spaceflight in 2004, it included an eight-year "learning period" to allow industry to innovate without excessive regulation, while allowing the FAA to write rules based on actual problems during licensed flights. Unfortunately, it's taken a long time for the industry to emerge, so Congress extended this for the full duration of the FAA reauthorization act in 2012, i.e. until September 30th of 2015. It is my understanding that FAA's Commercial Space Transportation Advisory Committee ("COMSTAC") has recommended that the learning period be restored to a full eight years from the first licensed flight of a spaceflight participant. Do you agree with the FAA advisory committee's recommendation?

No. Clearly there is no set period of years that we can foresee that will accomplish the objectives. And, as I pointed out in my testimony, because different technologies for transportation to space are being tested and all (or none) may work well, it will take different lengths of time for each to be ready for flight. An arbitrary cut-off of the experimental period will help some companies who are first to succeed and put others

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(with possibly better and more reliable systems) at a disadvantage. One solution is to extend the experimental period indefinitely, but once a company is ready to fly commercially, that experimental period ends for that company. In order to not encourage extended experimental periods, a company could be prohibited from flying paying passengers until its experimental period has ended. In keeping with the rules of the current legislation, if there is an accident during a company's experimental period, the oversight and rules to be applied to that company (and perhaps others using similar technologies) will change and the FAA will be able to impose more stringent rules.

3. Should companies be allowed to fly passengers for compensation on hybrid systems if they are not launching to space? How can the FAA allow flexibility to companies operating hybrid vehicles, but also not create a loophole in aviation regulations?

This question extends a bit beyond my technical expertise, but the answer appears to be fairly easy. If a vehicle is not going to outer space (i.e. defined as the edge of the atmosphere) and is not carrying a payload that will reach outer space, then it should not be under CSLA regulations but should be considered as an aircraft.

There might, however, be the need for a new category of aircraft with a regulatory authority that addresses any unique safety or liability problems of hybrid systems. My understanding of these vehicles is that if normal FAA Federal Aviation Regulations (FARs) are applied to them, they will never receive certification due to their associated higher risks and regulatory costs when compared to commercial aircraft. However, since they are not going to space, there is no particular advantage to having them regulated under the CSLA.

Note: It might be necessary in this case for the Congress to adopt an arbitrary altitude for regulatory purposes to distinguish between normal FAA aircraft jurisdiction and the jurisdiction of the CSLA. The most commonly used "rule-of-thumb" in the industry usually given for the edge of the atmosphere is a range of 90-110 km, averaged to 100 km. However, because some of the proposed vehicles may exceed this altitude, a more generous definition might be 120 km. Up to that point, the national jurisdiction of the airspace over a nation's territory would be applicable rather the specific laws that derive from the U.N. Outer Space Treaties.

It is also important to note that any definition of where outer space begins will be important mainly in the event of an accident between two or more vehicles from different nations that occurs at or near the boundary. An accident in that region is unlikely, but not impossible. The legal question that would be raised would involve what laws should be applied to the finding of liability and to resultant damages.

4. At the time that the CSLA was passed, every launch was regulated by 18 federal agencies. The Department of Transportation was given the lead on these efforts to make the process more efficient; however other agencies

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have recently become more involved in space launch and the space industry once again. How can the federal government pushback on this bureaucratic creep and ensure that as few agencies as possible are involved in regulating the space industry.

With great difficulty! Congress has already spread this burden of regulating commercial space affairs among a number of different agencies—DOC/NOAA for remote sensing satellites; the FCC for telecommunications satellites; and the DOT/FAA for launching. In addition, to name a few, the Departments of State, Treasury, and Commerce are involved in different aspects of export control. Every commercial license application for outer space use goes through a National Security review.

What appears to significantly hamper the regulatory aspects of commercial space is the Interagency Review process. It is reported to have become slow and bureaucratic, making timely and appropriate decisions on licensing space activities difficult and not always transparent.

Adding to issues of the process are the different mandates Congress has given each agency for the same issue. For example, the wording for disposing of satellites at the end of their lives is handled differently in the laws governing NOAA, and the FCC. Further complicating this issue is the DOD and NASA with coordinated, but different internal rules for disposing of their respective satellites. Although efforts are made for all agencies to meet and coordinate regulations, it is not always done well.

Therefore, given the span of expertise necessary for commercial space licensing, it probably is impractical for Congress to reduce the number of agencies involved. But the Congress can study this problem and adopt the same definitions and regulatory language for areas that overlap and are now treated differently among the agencies licensing commercial payloads.

In addition, the Congress could include in this interagency licensing review process for commercial space launches, payloads, or operations a clearly designated administrative appeal path to the highest levels of Government to resolve delays and/or adverse decisions.

5. In your testimony you advocate a transfer of authority from the commercial space office of FAA to the aviation office of FAA for all suborbital flights that do not enter outer space. There is already a definition of "suborbital trajectory" in the CSLA.
 - a. Is this definition insufficient to delineate authority between the Office of Commercial Space Transportation and the Office of Aviation Safety?
 - b. How would you define the line between space and the national airspace?

I addressed this issue on Pages 6 and 7 in my written testimony before this Subcommittee on 5 May 2011. Essentially, the current definition of a suborbital flight

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is a flight that has a parabolic trajectory and the payload does not gain enough speed to place it in orbit. This definition goes back many years and can be found also in NASA's aeronautics research program on sounding rockets. Over the years, our technology has changed and now sounding rockets can go as high as 1,500 km; over 15 times the distance where the atmosphere ends and clearly in the legal realm of outer space.

Today, these suborbital flights can, and do, cross two legal regimes—air space that is under national jurisdiction above the territory of a nation (except over the high seas) and outer space, which is an area with no sovereignty as defined in the U.N. space treaties.

The current plans for commercial suborbital flights are primarily to fly paying passengers to the edge of space and back. (In the future this may expand to locations in outer space and possibly into orbits.) Technically, these flights are not even space flights but will occur within the jurisdiction of U.S. airspace.

The question then is whether the FAA's FARs governing aviation are appropriate to this new industry or whether they fall into yet another category that is neither space nor aviation. Questions that will need to be addressed include: safety (risks greater than aircraft), liability, passenger classifications (are these vehicles common carriers or not?), and whether either regulatory authority, space or aviation, will be able to balance commercial interests of costs and operations with the safety of crew, passengers, and the general public.

There is no clearly accurate definition of the boundary between airspace and outer space. The UNCOPUOS has been debating this for 50 years without an answer. Please see my discussion in the answer to Question 3, above. The bottom line is that, if it becomes necessary, the Congress could define a border to apply only for jurisdictional and practical legislative/regulatory purposes under U.S. law.

6. In your testimony you point out that the Department of Transportation and the FAA have experience in administering rules concerning transportation, but not resource extraction or power generation. Activities that may need to be regulated in the future. If the FAA is not the appropriate agency to handle these activities, how do you propose the United States work with industry to ensure these activities are done safely and in compliance with international obligations?

I addressed this issue in response to Question 4, above. There are essentially two options: 1) establish new organizations or agencies to handle these activities or 2) expand the jurisdiction of existing space regulatory agencies. I would favor eventually establishing new regulatory authority where appropriate as determined by a number of factors as described in the answer to Question 4. (Size of the activity, need for special expertise, activities that are clearly different from those of today's use of space, and where those activities can benefit from expertise in regulations from similar

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Earth-based production such as energy or mineral extraction.) Besides having a more transparent Interagency Review process, it may be possible to adopt models for industry/government rule making that now exist in other areas such as nuclear energy. These models provide mechanisms for industry to have a greater role in determining the type and degree of regulation necessary while still retaining Government controls.

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The North American Electric Reliability Corporation, for example is a non-profit industry organization that is under the oversight of the FERC and develops and enforces Reliability Standards; annually assesses seasonal and long-term reliability; monitors the Bulk-Power System through system awareness; and educates, trains and certifies industry personnel.

7. Your testimony suggests the creation of new regulatory agencies to oversee various new ventures in space and to leave launch and reentry to FAA's Office of Commercial Space Transportation. Is it practical to create new agencies at this point in the development of the industry?
 - a. What types of new agencies would you advise be created and to whom should they report?

My testimony did suggest new agencies. However, the thrust of what I was suggesting was to look within the Government for the proper expertise to address new issues that new industries and activities will inevitably create when operating in outer space. At the present time there would be little benefit in establishing new agencies to handle each new problem or issue, and even if Congress did establish new organizations, they would be without much work for the foreseeable future.

It is also not feasible right now to be specific about the activities involved. There are numerous paper proposals for using space for energy and for resources. Each activity will require extensive R&D, many years to mature, and significant financing. All are possible and as technologies develop will likely occur. But today the specific expertise and parts of existing Government agencies that would best be able to advise on regulations cannot be designated until these activities emerge and actually need a license to operate.

The DOT/FAA has been given regulatory authority over launch and space transportation activities. The Office of Commercial Space is a small organization and does not have the expertise or mandate to regulate non-transportation activities in outer space. The question to be addressed when a company applies for a license to launch a payload that will perform new activities in space (and is not a remote sensing or telecommunications payload) is where and how the process of licensing those activities occurs.

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The U.S. Government, by international treaties it has ratified, remains not only liable for even a company's activities in space, but also is responsible for continuous supervision over all national activities in space. Therefore the Congress will have to develop a legal regime to address these issues. Whether it will be the responsibility of the FAA to coordinate the process (and acquire the appropriate expertise from other agencies), or new organizations need to be formed is an open question. Answers cannot be prescribed easily today. The need is currently undefined and the number of companies and size of the planned activities will also determine that need. If they are experimental and "one-off," they can likely be handled efficiently by an existing Federal Agency. However, if they grow into significant operations and/or incur the possibility of large liabilities, then a separate licensing/supervisory organization might be necessary.

8. In your testimony you point out that there is currently no effective dispute resolution system for accidents involving private space assets. How do you propose to remedy this situation? Your suggestion for binding arbitration would require both nations to agree; how practical is a system set up in this manner and how do you envision it working in practice?

I have attached a paper I co-authored last year on this topic and provides a more complete answer to that question.

The essence of the argument is that today, with the advent of commercial space, we (the U.S. and other nations together) have no effective way of handling disputes over outer space matters other than through diplomatic means. Courts such as the International Court of Justice require States to argue the issues and have no enforcement powers for their decisions.

Binding arbitration is not a perfect answer to effective dispute resolution. However it is a system that the commercial sector routinely uses to solve disputes in international commerce. Most nations have ratified treaties that bind those nations to enforce the decisions of tribunals that are held under agreed upon rules for arbitration.

Commercial space operators, particularly in the satellite business commonly include binding arbitration in contract clauses. However, those contracts are written between companies doing business with each other. If an accident occurs between commercial satellites in space from different nations (launching states), the parties are not likely to have any formal contractual relationship.

In order to establish a regime of binding arbitration for space accidents, it would be necessary for each government in its licensing framework to require binding arbitration if the parties involved in an accident cannot otherwise resolve the dispute within some given time period after the accident (perhaps one or two years).

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It is also clear that a number of space-faring nations would have to initiate this practice together within a short period of time. I am suggesting that the United States begin to discuss with other major space-faring nations this possibility. And, there is no reason why the U.S. cannot include this as a licensing provision—it may help to speed the process, and the provision would be moot if other nations did not reciprocate. In other words, it does no harm, and might be beneficial.

All aspects of this suggestion need further study. There are precedents in other sectors for using binding arbitration as a dispute resolution mechanism, but space is unique and there may be issues that will be raised that are problematic and non-obvious. Also, an open question for Congress is whether such a provision should apply only to commercial payloads or whether the U.S. Government itself would agree to submit government payloads to binding arbitration as well.

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Questions for the Record from Ranking Member Edwards: "Necessary Updates to the Commercial Space Launch Act" February 4, 2014

1. Should the policy and regulatory framework for commercial space transportation be one-size-fits-all or should there be different regimes for commercial human space transportation and for commercial unmanned space transportation, including for indemnification and safety regulations?

I believe that different regimes will be necessary. Technological advances are beginning to mature and new private ventures are beginning to attract investment financing and inevitably some will succeed. On the unmanned side, the proposals range from inexpensive nano- and cubesats to cargo services and even deeper space exploration. The locations of their activities spread from very low orbits to deep space and in some cases, other planets. Private human space activities are quite different, and likely will be tied to government programs for the foreseeable future because of the very large amounts of money and risk necessary.

The risks and safety aspects of all of these activities that will occur in outer space are currently not well addressed. For example, liability in outer space is fault-based. To date there have been no accidents in outer space that have resulted in enough economic damage to warrant the recovery of loss. The space treaties do not define fault or negligence, nor do they include any mention of what is the duty of care or due diligence expected of an actor in space. Liability and damages are ultimately the responsibility of a government. Just as with launches, it is likely that most governments will require some form of a transfer of part or all of this liability to a company that is involved in outer space for-profit activities. But activities in space are inherently different from launches and therefore the method and levels of indemnification/insurance will need to be addressed, as will the associated protocols for safety regulations.

We will also need to better define what is transportation in space and what are "other" activities. Is landing on the Moon included in transportation? What about piloting a vehicle on the Moon? What if that same vehicle is equipped with tools to dig? Would the same definitions also apply to asteroids? Is transmitting energy from a space platform to another space platform or to Earth equivalent to transmitting communications signals or is it equivalent to transporting coal from the mine to the factory? These practical definitions do not exist but we will someday need to clarify our activities and develop different rules and regulations to different activities that will match the risks and costs for each.

2. As you know, although the point at which FAA can impose human spaceflight safety regulation has been extended, some in industry believe additional time is needed.
 - In your opinion, what specific knowledge should we aim to nail down during a "learning period" before FAA imposes safety regulations on commercial space vehicles?

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- Is there a downside to not establishing a set time for regulations to be imposed?
- Should there be a different set of regulations for suborbital and orbital flight vehicles?

I have addressed most of these issues in my answer to Rep. Palazzo's Question #2.

The question of what specific knowledge to have during a "learning period" is a technical one. I am not expert enough in flight hardware or systems to answer that. But, as I suggested, it may be an issue that will be answered by companies and the FAA together as they do on the aviation side: when a vehicle is ready for a certificate of flight worthiness, the required systems have all been certified and the experimental period is over. If a vehicle is ready to carry paying passengers on a for-profit basis, it should be regulated as such and subject to more stringent rules than during an experimental period of testing.

3. In addressing the issue of indemnification and its impact on competitiveness, you indicated in your prepared statement that with the exception of terminating the Government's guarantee of indemnification, it is "unlikely CSLA or any changes to it will significantly alter the competitiveness of U.S. launch companies". Why do you believe this to be the case?

Very simply, since other nations guarantee indemnification and continue to do so, the U.S. competitive advantage is similar in that aspect of space launches. If the U.S. terminates the guarantee, and if other nations do not, U.S. companies would lose one aspect of the competitive edge.

Even though insurance schemes are in place to cover most expected 3rd party liability, and even though historically the payouts on this liability have been very minor and the premiums paid for this part of launch insurance are relatively small, the psychological safety net is very important for launch companies.

Furthermore, even if the Government changes or drops its indemnification, legally the Government could still be found liable as the space treaties that the U.S. has ratified, in all but rare cases, ultimately leave the Government, as a launching State, fully liable for all damages from its vehicles or payloads in space forever. (The same is true for every other space-faring nation.)

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4. Following up on your point on how FAA has interpreted its role in situations not involving launch and reentry of space vehicles, you listed a number of situations where FAA's jurisdiction is questionable, such as commercial high altitude balloons and resource extraction on celestial bodies. As a result, you recommended that Congress study these issues and allocate future jurisdiction over non-transportation issues to agencies with the required expertise. Do you have any suggestions on the framework Congress could use to begin looking at these issues? What priority areas should Congress tackle first?

See my answer to Rep. Palazzo's Question #6.

Currently this problem may best be handled by working on making the Interagency coordination of licensing more efficient, speedier, and more transparent. Also identifying all of the legislation and implementing regulations of the FAA, NOAA, and the FCC, (as well as the operating rules of DOD and NASA) for inconsistencies in their rules regarding identical issues and revising and re-defining those law and regulations to make them as uniform as possible would improve the system.

When expertise is needed outside of the current space agencies or regulatory authorities, the Congress can address this by either establishing new agencies if the activity warrants, or by requiring expertise to be shared by an Agency within the current system as necessary.

